CITY AND COUNTY OF SAN FRANCISCO

REPORT ON

WATER POLLUTION CONTROL PLANTS

REPORT 1 – PHASE I

EXISTING OPERATION AND PLANT PERFORMANCE

MARCH 1971

BROWN AND CALDWELL
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FIELD WORK

R. Boswell	J. Morgal
W. Gomez	O. O'Neal
J. Kardash	R. Septon
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G. Mah	

REPORT PREPARATION

M. A. Earl	A. H. Morilla
C. Healy	C. S. Reser

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Mr. S.M. Tatarian, Director
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City & County of San Francisco
260 City Hall
San Francisco, California 94102

WATER POLLUTION CONTROL PLANTS - REPORT 1, PHASE I

In accordance with our agreement dated June 10, 1970, we are submitting Report 1, Phase I on the work covered by our agreement. Results of the work performed under Phase I are being submitted in two sections, the first dealing with existing operational procedures and plant performance and the second with reductions necessary to achieve various levels of effluent quality as prescribed by the San Francisco Bay Regional Water Quality Control Board. The report submitted with this letter presents an analysis of existing operations at the City's three water pollution control plants and the results of a sampling program indicating present performance and efficiency at the three plants.

We will be happy to meet with you or your staff to discuss our report at any time you may desire.

BROWN AND CALDWELL

Frank J. Kersnar

Frank J. Kersnar

CONTENTS

CHAPTER 1

INTRODUCTION

By Resolution Nos 69-44 and 70-17, the San Francisco Bay Regional Water Quality Control Board required the City and County of San Francisco to submit an engineering report on the Southeast and North Point water pollution control plants evaluating the requirements and costs of producing effluents of specified characteristics. The resolutions state in part:

The discharger is required to submit the following reports to this Board on or before November 30, 1969:

"A firm and detailed time schedule for the preparation of a preliminary engineering report and cost estimates for facilities needed to comply with the above requirements for floatables, turbidity, discoloration and settleable matter. For purposes of said report the discharger shall use the following numerical ranges:

Reduction in receiving water clarity	5 to 30% in 90% of the determinations made on any day in the area of greatest turbidity
Floatables in the receiving water at any place	10 to 50 mg/square meter
Grease in the effluent	5 to 30 ug/l
Settleable matter in the effluent	In any grab sample: The arithmetic average of any six or more samples collected on any day - 0.5 ml/l/hr maximum 80% of all individual samples collected during maximum daily flow over any 30-day period - 0.4 ml/l/hr maximum Any sample - 1.0 ml/l/hr maximum"

"....The Board expects the discharger to report on the type of facilities needed and the cost of complying with various numberical values within the above ranges...."

To fulfill these requirements, the City and County of San Francisco, acting through its Department of Public Works, engaged the firm of Brown and Caldwell to prepare the necessary engineering reports evaluating present plant performance and developing improvements necessary to comply with the above listed numerical limits. Although not required by the Regional Board, the city included the Richmond-Sunset water pollution control plant in the study.

Under the terms of an agreement for engineering services dated June 10, 1970, the required work is divided into two phases. Phase I involves a determination of existing conditions and Phase II involves an evaluation of process and operational changes. Separate reports are required for the two phases.

Objectives and Scope of Phase I Study

The primary objective of the Phase I study is to identify the quantities and qualities of the materials present in the influent, process streams and effluent of each of the city's three water pollution control plants. Under the terms of the agreement for engineering services, work to be performed included the following:

1. Review of present plant operations and processes to determine existing conditions, modes of operation, and sampling points.
2. Analysis of the influents, in-plant operation and process streams, effluents and receiving water conditions for the parameters listed in the Regional Board's resolutions.
3. Determination of reductions at average and peak flow conditions required to attain at least four levels of effluent and receiving water quality for which one or more levels shall comply with the ranges of objectives, requirements and goals as specified by the Regional Board.
4. Determination of the assimilative and dispersive capacity and background quality of the waters into which the Southeast water pollution control plant discharges and evaluation of the existing Southeast water pollution control plant outfall.
5. Preparation of a final report for Phase I presenting and discussing all information developed in this phase of the investigation and including recommendations and scope for investigations to be undertaken during Phase II of the study.

The report on Phase I investigations is submitted in two sections. The first section, which this report includes, covers a review of present plant operation and performance as included in the first two items listed above. The second section, which is submitted in a separate report, covers the reductions necessary to meet the Regional Board ranges of objectives, goals and requirements and the recommendations and scope for Phase II investigations.

Abbreviations used in this report are defined in Appendix A.

Field and Laboratory Work

Field and laboratory work was concerned primarily with the following activities:

1. A determination of the existing conditions and present modes of operation in each of the city's water pollution control plants. The information collected was developed through meetings with plant supervisory personnel and numerous visits to the treatment plants. Detailed descriptions of the treatment units and the way they are presently operated are given in Chapter 2.
2. A determination of process sampling points in each treatment plant. Selection was made after field inspections and discussions with plant supervisory personnel, the Bureau Superintendent and the Sewage Treatment Division General Superintendent of the City's Bureau of Water Pollution Control of the Department of Public Works.
3. A determination of the quantities of process streams necessary to evaluate the loadings of the treatment units and the amount of recycled flows through the plants. For this phase of the work, temporary measuring devices were built and installed at selected locations. Continuous flow records were obtained with the aid of float and pneumatic recording equipment. Further details of these procedures are given in Chapter 3.
4. A determination of the composition of influent, in-plant and process and effluent flows through a comprehensive sampling program in each treatment plant. Samples were collected manually at each location by study personnel for seven consecutive days, 24 hours a day. Samples were composited in a trailer especially equipped for this program and stored in chilled containers. Field determinations were made for some parameters immediately after the samples were collected. Analysis of sample constituents were made in several specialized laboratories, including the treatment plant laboratories.
5. A study of the waters of San Francisco Bay in the vicinity of the Southeast treatment plant discharge to determine the effects of existing sewage disposal practices.

Office Work

Office work was concerned with the following principal activities:

1. A review of the water pollution control plant and basic operation data, design drawings and general information furnished by the staff of the Sanitary Engineering Division of the Bureau of Engineering.
2. The development of plant flow diagrams and hydraulic profiles for average flow and estimated maximum hydraulic capacity.
3. A determination of process loads and mass distribution for each of the treatment plants.
4. A determination of efficiencies of present treatment units.
5. The preparation of Report 1 of Phase I.

Information and Data Available to Survey

Existing reports, plans, specifications and statistical information relating to the city's water pollution control plants were furnished by the staff of the Bureau of Engineering and Bureau of Water Pollution Control of the City's Department of Public Works.

Progress Reports

Written reports on the progress of the study were made monthly to the Director of Public Works. Additionally, periodic meetings were held with the staff of the Sanitary Engineering Division to discuss the study progress and preliminary findings. Some information collected during the course of Phase I was also made available at the request of the Sanitary Engineering Division.

Acknowledgements

For their assistance during the study, we wish to express our appreciation to A.O. Friedland, R.T. Cockburn and W.R. Giessner and other members of the staff of the Division of Sanitary Engineering of the Bureau of Engineering and to K. Fraschina, J.H. Crafts, A.E. Bagot, W.C. Jow, L.T. Yew, R. Loucks, P. Shinn, N. Lago, A. Benas, C. Zern and D. McNulty of the Sewage Treatment Division of the Bureau of Water Pollution Control and other personnel of the Sewage Treatment Division of the Bureau of Water Pollution Control.

CHAPTER 2

REVIEW OF EXISTING TREATMENT PLANT OPERATION MODES

The City of San Francisco is divided into three sewerage service areas, each of which is served by a primary treatment plant. The three plants are the North Point, Richmond-Sunset and Southeast Water Pollution Control Plants. The location of each of the plants and its outfall, together with the approximate area it serves, is shown on Fig. 2-1.

NORTH POINT WATER POLLUTION CONTROL PLANT

The North Point Water Pollution Control Plant, completed in 1951 at a project cost of $8,500,000. serves a dry weather flow area of approximately 9,300 acres. The tributary area is mostly residential in character but includes also commercial and industrial developments along the Port of San Francisco.

The plant architectural appearance is pleasant and the buildings blend successfully with their surroundings. The treatment units are arranged in two groups of buildings with the pretreatment building (screens and grit tanks) and the influent pumping station and administration building located on the south side of Bay Street and the preaeration and sedimentation buildings, postchlorination building and maintenance building on the north side.

Sewage Treatment

The plant provides conventional primary treatment consisting of prechlorination, screening, grit removal, preaeration and primary sedimentation, and postchlorination. Due to the residential nature of the area where the plant is situated, all treatment units are housed for odor control. A flow diagram of the various treatment units and the functions that they perform is shown on Fig. 2-2. Design and actual process and equipment data are given in Table 2-1. Hydraulic profiles showing water surface elevations at present average dry weather flow and estimated maximum hydraulic capacity of the North Point plant are presented in Fig. 2-3.

Emergency Bypass. The treatment plant capacity during wet weather is based on a rainfall intensity of 0.02 inches per hour. This provides sufficient capacity to treat all dry weather flows. Flows resulting from rainfall in excess of 0.02 inches per hour are bypassed directly to San Francisco Bay. Bypassing takes place when the flow reaches approximately 160 mgd and is accomplished by throttling a 72 by 72-in. inlet gate to the plant. In case of a power failure a separate 72 by 72-in. inlet gate closes automatically and all the flow is bypassed to the bay. The hydraulic system for the inlet and throttling gates operates from the plant high pressure No. 2 water system. It takes approximately 6 min for the gates to close fully under emergency conditions.

Screenings. After passing through the throttling sluice gate the flow is divided into four channels. Each channel is provided with a 60 by 60-in. hydraulically operated inlet sluice gate, a 5-ft wide manually cleaned coarse bar rack and a 10-ft wide mechanically cleaned bar screen.

The inlet gates are used to select the in-service channel. The coarse bar racks extend only about two feet below the sewage surface at design flow. Their object is to protect the mechanical bar screens from damage caused by large floating debris which often finds its way into the incoming sewer.

The mechanical bar screens are of the straight-line front clean, front return type provided with one cleaning rake. Compressed air is injected through diffuser plates both in front and behind the bar screens to prevent grit from settling in the area. The mechanical bar screens run continuously when they are in service. Screenings are brought up from the bar screen by the cleaning rake and deposited into 20 cu ft capacity storage buckets. When a storage bucket is full it is lifted to the ground floor of the pretreatment building and dumped into an open dump truck. Truck loads of grit and screenings are hauled to the city dump daily, Monday through Friday.

Grit Removal. Immediately after passing through the fine screens, the incoming sewage flows into the grit chambers. Each grit chamber is directly connected to a screen channel thereby requiring these two process elements to operate as a single unit.

Each of the four grit chambers is 96 ft long and 10 ft wide. Chamber depth varies in direct relationship to flow and is controlled by a 4-ft Parshall flume at the downstream outlet from the chamber. Each flume measures the flow through its chamber and operates with free discharge under all hydraulic flow conditions. A hydraulically operated sluice gate downstream of each Parshall flume provides a means of isolating each chamber from the system.

Settled grit is moved to the inlet end of each chamber by continuous chain flights which operate along the entire bottom of the chamber. At the inlet end of the chamber a screw conveyer picks up the grit and raises it to the operation floor level and

Table 2-1 Process and Equipment Data - North Point Plant

	Design[a]	Present[b]
SEWAGE TREATMENT		
Basic Data		
Population, 1,000's		
Flow, mgd, rate		
Minimum dry weather, (min/avg/max)	-/15/-	28/30/32[c]
Average dry weather, (min/avg/max)	-/65/-	51/59/63[c]
Peak dry weather, (min/avg/max)	-/-/-	69/79/86[c]
Peak wet weather, (min/avg/max)	-/150/-	81/130/170[d]
Maximum hydraulic capacity	190	190
Loadings, 1,000 lbs/day		
Suspended solids, (min/avg/max)	-/216/-	68/95/120[c]
5-day, 20°C, BOD, (min/avg/max)	-/190/-	68/97/110[c]
Main influent gates		
Number	1	1
Size, inches	72 x 72	72 x 72
Throttling gates		
Number	1	1
Size, inches	72 x 72	72 x 72
Screening		
Coarse screens		
Number	4	4
Clear spacing, inches	4	4
Mechanically cleaned bar screens		
Number	4	4
Channel width, feet	10	10
Bar thickness, inches	3/8	3/8
Clear openings, inches	3/4	3/4
Average screening removal, cu ft/mil gal	-	2.9[d]
Grit Removal		
Grit tanks		
Number	4	4
Length, feet	96	96
Width, feet	10	10
Maximum depth, feet	6.5	6.5
Parshall flumes		
Number	4	4
Throat width, feet	4	4
Grit pumps		
Number	2	4
Flow, gpm/pump	200	400
Speed, rpm	1,200	1,750
Grit washers		
Number	2	2
Capacity, ton/hr total	4	4
Average grit removal, cu ft/mil gal	-	3.4[d]
Grit hoppers		
Number	2	2
Capacity/hopper	300	300
Aeration blowers		
Number	4	5
Capacity, cfm	2 @ 220: 2 @ 600	2 @ 220: 2 @ 600 1 @ 870
Effluent Pumping		
Raw sewage sumps		
Number	2	2
Maximum volume, each sump, 1,000 cu ft	77.5	77.5

Continued on next page

Table 2-1 Process and Equipment Data - North Point Plant (Continued)

	Design[a]	Present[b]
Influent Pumping (continued)		
Detention time, hrs		
Minimum dry weather flow, 1 sump (15,30 mgd)	0.72	0.36
Average dry weather flow, 1 sump (65,59 mgd)	0.28	0.30
Peak wet weather flow, 2 sumps (150,130 mgd)	0.14	0.16
Maximum hydraulic capacity, 2 sumps	0.11	0.11
Sump grit pumps		
Number	3	3
Capacity, gpm/pump	200	300
Sump scum pumps		
Number	2	2
Capacity, gpm/total	1,500	1,500
Sump dewatering pumps		
Number	2	2
Capacity, gpm/total	1,800	1,800
Raw sewage pumps		
Number	5	5
Capacity, mgd		
No. 1	50	50
No. 2	40/20	40/20
No. 3	40/20	40/20
No. 4	30/15	30/15
No. 5	30/15	30/15
Force mains		
Number	5	5
Diameter, inches	48	48
Preaeration and Primary Sedimentation		
Preaeration Tanks		
Number	6	6
Length, feet	74	74
Width, feet	38	38
Average depth, feet	10.7	10.7
Detention time, hrs, all tanks operating at average dry weather flow, (65,59 mgd)	.50	.55
Preaeration air blowers		
Number	6	5
Capacity, cfm/blower	870	870
Pressure, lbs/in^2	7	7
Primary sedimentation tanks		
Number	6	6
Length, feet	223	223
Width, feet	38	38
Average water depth, feet	11.4	11.4
Detention time, hrs, all tanks operating at average dry weather flow, (65,59 mgd)	1.50	1.70
Overflow rate, gal/sq ft/day, all tanks operating at average dry weather flow, (65,59 mgd)	1,280	1,160
Mean forward velocity, ft/min, all tanks operating at average dry weather flow, (65,59 mgd)	2.3	2.1
Chlorination		
Storage tanks		
Number	2	2
Diameter, inches x length, feet	85 x 32.67	85 x 32.67
Capacity, per tank, tons	50	50
Evaporators		
Number	6	3
Capacity, lb/day/evaporator	3 @ 4,000 3 @ 6,000	8,000

Continued on next page

Table 2-1 Process and Equipment Data - North Point Plant (Continued)

	Design[a]	Present[b]
Chlorination (continued)		
Chlorinators		
Number	6	3
Capacity, lb/day/chlorinator	3 @ 4,000 3 @ 6,000	8,000
Dosage rates, lb/mil gal		
Prechlorination	30	25
Postchlorination	90 - 100	72.5
Chlorine contact tank		
Diameter, feet	50	50
Detention time, minutes		
Average dry weather flow, (65,59 mgd)	2.7	2.9
Maximum hydraulic capacity, high tide	-	1.5
Maximum hydraulic capacity, low tide	-	1.2
Effluent Disposal		
Outfall sewer		
Average length, feet	1,600	1,600
Size, feet	8, 6 & 4	8, 6 & 4
SOLIDS TREATMENT		
Sludge and scum removal		
Raw sludge pumps		
Number	6	6
Capacity, gpm/pump	300/50	250
Scum pumps		
Number	2	2
Type	centrifugal	centrifugal
Capacity, gpm/pump	300	300
Raw sludge sumps		
Number	2	2
Volume, cu ft/sump	620	620
Solids Disposal		
Sludge disposal pumps		
Number	2	2
Capacity, gpm/pump	700/1,000	600/1,050
Head, feet	90/203	90/203
Force main to Southeast		
Diameter, inches	10	10
Length, miles	6	6
Average velocity, fps, (600/1050 gpm)	-	2.4/4.2
Detention time, hours, (600/1050 gpm)	-	3.7/2.1
SUPPLEMENTAL FACILITIES		
Ventilation		
Pretreatment building		
Supply fans		
Number	2	2
Capacity, 1,000 cfm/fan	13 & 8	13 & 8
Exhaust fans		
Number	2	2
Capacity, 1,000 cfm/fan	52 & 11	52 & 11
Administration and pump building		
Supply fans		
Number	3	3
Capacity, 1,000 cfm/fan	20, 11 & 7	20, 11 & 7
Transfer fans		
Number	2	2
Capacity, 1,000 cfm/fan	33 & 14	33 & 14
Exhaust fans		
Number	1	1
Capacity, 1,000 cfm/fan	39	39

(continued on next page)

Table 2-1 Process and Equipment Data - North Point Plant (Continued)

	Design[a]	Present[b]
Ventilation (continued)		
Receiving structure		
Supply fans		
Number	1	1
Capacity, 1,000 cfm/fan	4	4
Exhaust fans		
Number	1	1
Capacity, 1,000 cfm/fan	4	4
Preaeration and Sedimentation Buildings		
Supply fans		
Number	3	3
Capacity, 1,000 cfm/fan	15, 7 & 6	15, 7 & 6
Exhaust fans		
Number	3	3
Capacity, 1,000 cfm/fan	44, 42 & 21	44, 42 & 21
Sludge Control Building		
Supply fans		
Number	1	1
Capacity, 1,000 cfm/fan	13	13
Exhaust fans		
Number	1	1
Capacity, 1,000 cfm/fan	35	35
Postchlorination building		
Supply fan		
Number	1	1
Capacity, 1,000 cfm/fan	15	15
Utilities		
No. 1 water system pumps		
Number	2	2
Capacity, gpm/pump	50	50
No. 2 water system pumps		
Number	3	3
Capacity, gpm/pump	400	400
No. 3 water system high pressure pumps		
Number	3	3
Capacity, gpm/pump	500	500
No. 3 water system low pressure pumps		
Number	3	3
Capacity, gpm/total	2,200	2,200
Steam cleaners		
Number	5	5
Capacity, lbs/min/cleaner	70	70
Plant heating system		
Number of boilers	2	2
Number of condensate pumps	1	1
Capacity, gpm/pump	30	30

[a] Data represents information developed from original initial construction drawings and information supplied by paper entitled "Municipal Sewage and Waste Treatment - Treatment Plants" as prepared by the Sewage and Waste Division of the Bureau of Sewer Repair and Sewage Treatment in 1958.

[b] Unless otherwise noted, data represents actual field observations, office calculations and information obtained from city engineering and plant personnel.

[c] Based on flow measurements and samples taken during 7-day sampling program.

[d] From "Summary of Treatment Plant Operation", 1969-70.

dumps it into a sluice trough from where it is flushed with No. 3 water to one of two grit collection sumps. Flights and screw conveyers operate continuously whenever the grit chamber is in service. Each grit collection sump serves two grit chambers and is located next to the outside chamber of each pair.

Normally at least two grit chambers are in service. When the flow entering the treatment plant reaches about 60 mgd a third unit is manually started by opening its inlet gate. If flow continues to increase, the fourth unit is placed in service when the flow reaches about 82 mgd. Between 82 mgd and 160 mgd all four units remain in operation. The plant throttling gate is actuated at flows in excess of 160 mgd. When the flow drops to 75 mgd, one unit is taken out of service and when it decreases below 50 mgd, a second unit is shut down. Equal flow distribution is attempted by throttling the inlet gate to each combination bar screen-grit chamber unit.

To prevent development of septic conditions in a grit chamber when it is out of service, compressed air is injected along its entire length through a system of 3/8-in. diffusers. Compressed air is supplied by five blowers with a total capacity of 2,500 cfm. In addition to supplying the air required for the grit chambers, these blowers also supply the air required by the diffuser plates located on either side of the mechanical bar screens.

Grit Disposal. Grit disposal is achieved by pumping the grit from the collection sumps to grit washers that in turn deposit it into storage bins from which it is hauled to the city dump.

Adjacent to each grit collection sump is a dry well where two grit pumps are located. The grit pumps are constant speed units which, although they cannot be run simultaneously, are driven by a single electric motor with a special V-belt and clutch arrangement. Grit pump operation is controlled by a timer. A float controlled valve admits No. 3 water into the sump when the level drops below a preset elevation.

Grit pumps discharge grit slurry from the sumps into two grit washers of the reciprocating rake type. Washed and dewatered grit is dumped into two 300 cu ft storage bins from which it is loaded in trucks and hauled away for disposal. Overflow from the grit washers is returned to the plant influent upstream of the coarse racks.

Influent Pumping. Sewage leaving the grit chamber Parshall flumes flows via a 10-ft wide concrete channel to the receiving well of the influent pumping station located in the basement of the administration building. The structure is of the "wet-well" design generally associated with the use of constant speed pumps.

The receiving well is divided into two 111 by 43.5-ft sumps, east and west, with a combined storage volume of about 900,000 gallons. Originally, both sumps were equipped with scum skimming and grit removal systems. Scum and grit pumps are still used, but the continuous chain grit scrapers were removed in 1965 and the skimming nozzles are not being used at present. The sumps are provided with grated walkways but the layout of the ventilation ductwork makes the headroom very limited. Lighting conditions in the area are poor. The sumps can be drained using two 1800 gpm dewatering pumps. At the time this study was made, the grit scrapers were being reinstalled.

The five raw sewage pumping units are of the mixed flow type and are located in a 6,000 sq ft room approximately 36 ft below ground level. Four of the units are dual speed with two having a capacity of 15/30 mgd and two having a capacity of 20/40 mgd. The fifth unit is constant speed having a capacity of 50 mgd. The pumps are arranged so that one 15/30 mgd and one 20/40 mgd pump are connected to each sump while the 50 mgd unit can pump from either sump through a double gate arrangement. Grit, scum and sump drain pumps are located in a separate room at a lower elevation. Each influent pump discharges independently to a receiving structure on the north side of Bay Street through a 48-in. reinforced concrete pipe provided with a flap gate for backflow prevention. The scum and drainage pumps discharge into the channel that connects the receiving structure with the primary sedimentation tanks.

Under normal operating conditions both sumps are in service. At present, raw sewage pumping is controlled manually from the main control room situated in the administration building. The automatic control system originally provided was discontinued shortly after the plant was put in operation apparently due to surges caused by the starting and stopping of the pumps. Pumps are started and stopped according to flow variations trying to maintain sump level variations within a 2 to 3-ft range. To avoid large changes in output, the scum and sump drainage pumps are also used for raw sewage pumping.

Preaeration and Primary Sedimentation. Primary settling takes place in six combination preaeration-sedimentation tanks. Tanks are divided into two groups of three and housed in separate buildings. Each tank is 233 ft long, 38 ft wide with an average depth of 10.7 ft at the design flow of 65 mgd. Detention time at design flow is 2 hours. Fig. 2-4 shows detention time overflow rate and mean forward velocity plotted against flow for each tank.

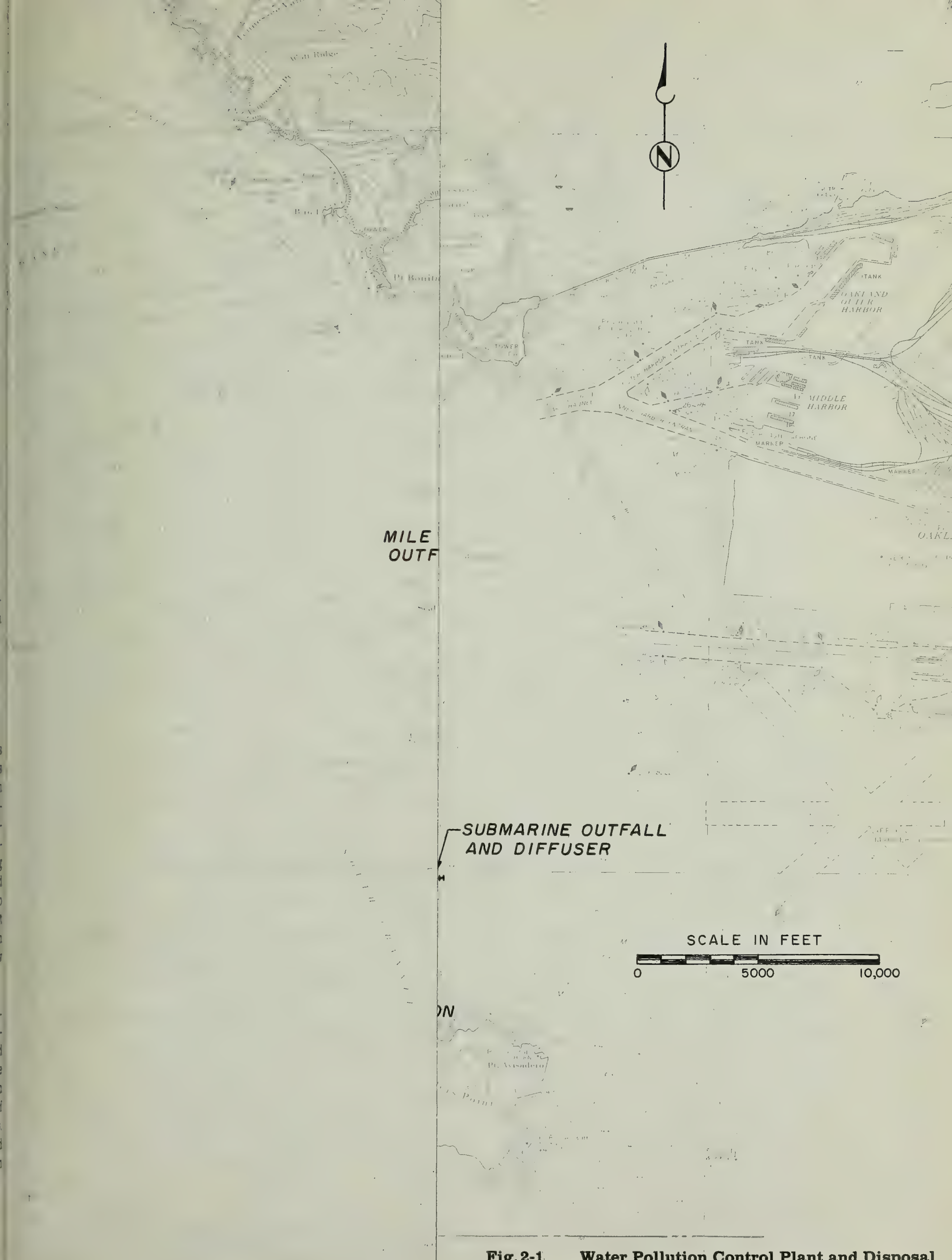
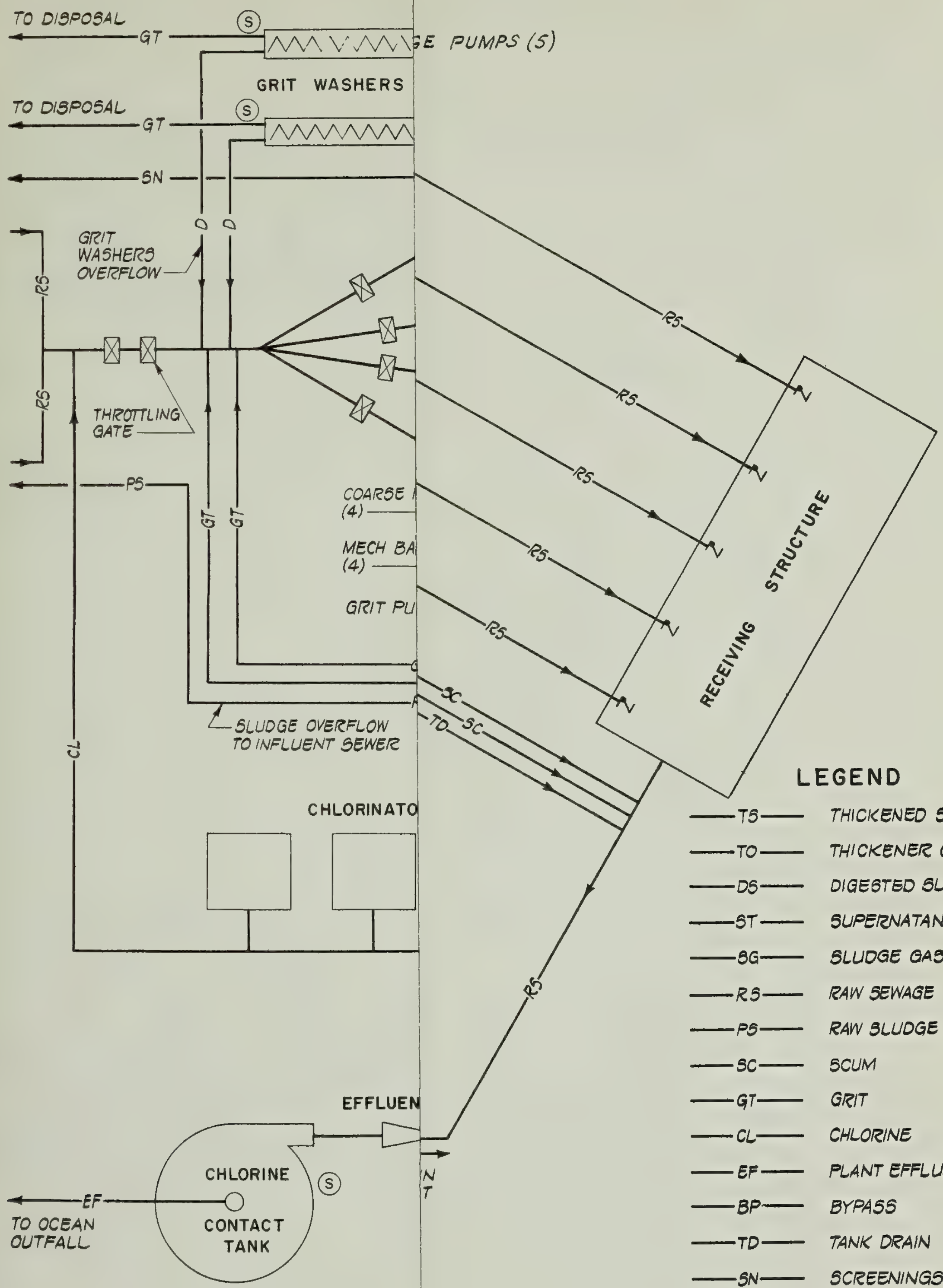


Fig. 2-1 **Water Pollution Control Plant and Disposal Facilities**

Fig. 2-1 **Water Pollution Control Plant and Disposal Facilities**



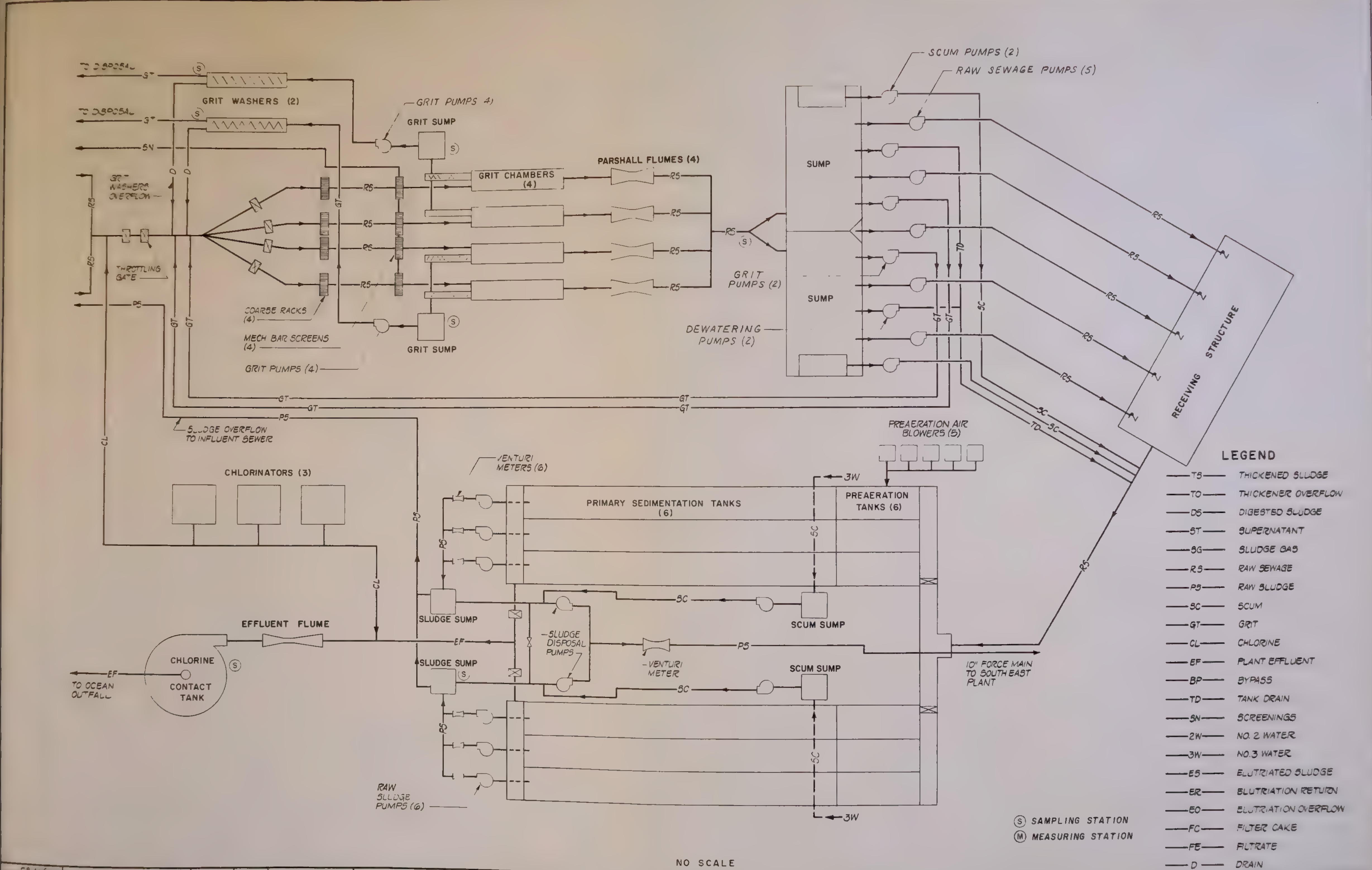
LEGEND

—TS—	THICKENED SLUDGE
—TO—	THICKENER OVERFLOW
—DS—	DIGESTED SLUDGE
—ST—	SUPERNATANT
—SG—	SLUDGE GAS
—RS—	RAW SEWAGE
—PS—	RAW SLUDGE
—SC—	SCUM
—GT—	GRIT
—CL—	CHLORINE
—EF—	PLANT EFFLUENT
—BP—	BYPASS
—TD—	TANK DRAIN
—SN—	SCREENINGS
—2W—	NO. 2 WATER
—3W—	NO.3 WATER
—ES—	ELUTRIATED SLUDGE
—ER—	ELUTRIATION RETURN
—EO—	ELUTRIATION OVERFLOW
—FC—	FILTER CAKE
—FE—	FILTRATE
— D —	DRAIN

) SAMPLING STATION

) MEASURING STATION

DRAWN D.S. Aspinall CHECKED	DESIGNED SUBMITTED Warren R.	APPROVED APPROVED	NORTH POINT PLANT FLOW DIAGRAM	SHEET NUMBER OF	DRAWING NUMBER Fig. 2-2



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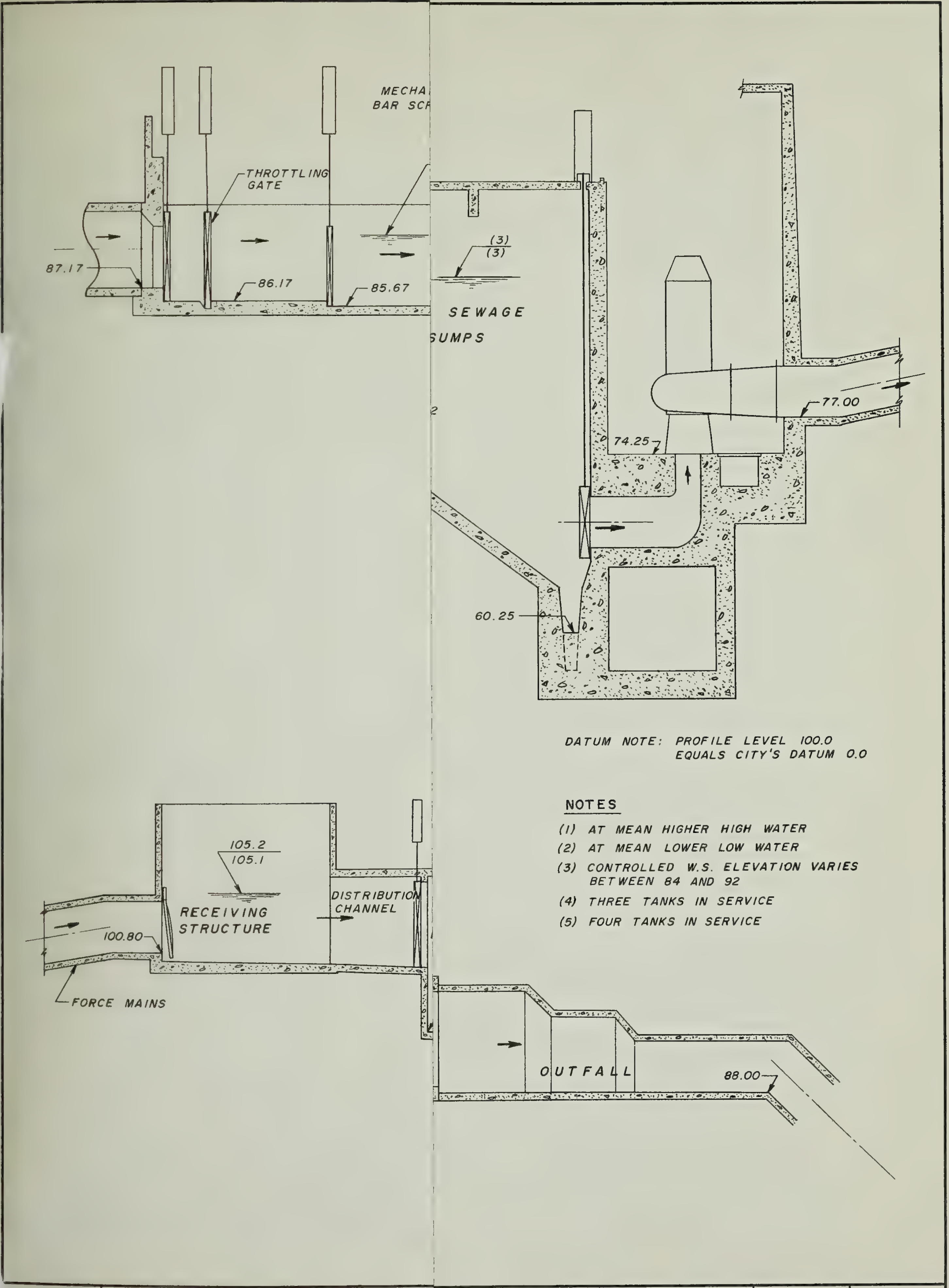
SAN FRANCISCO - ALHAMBRA, CALIFORNIA

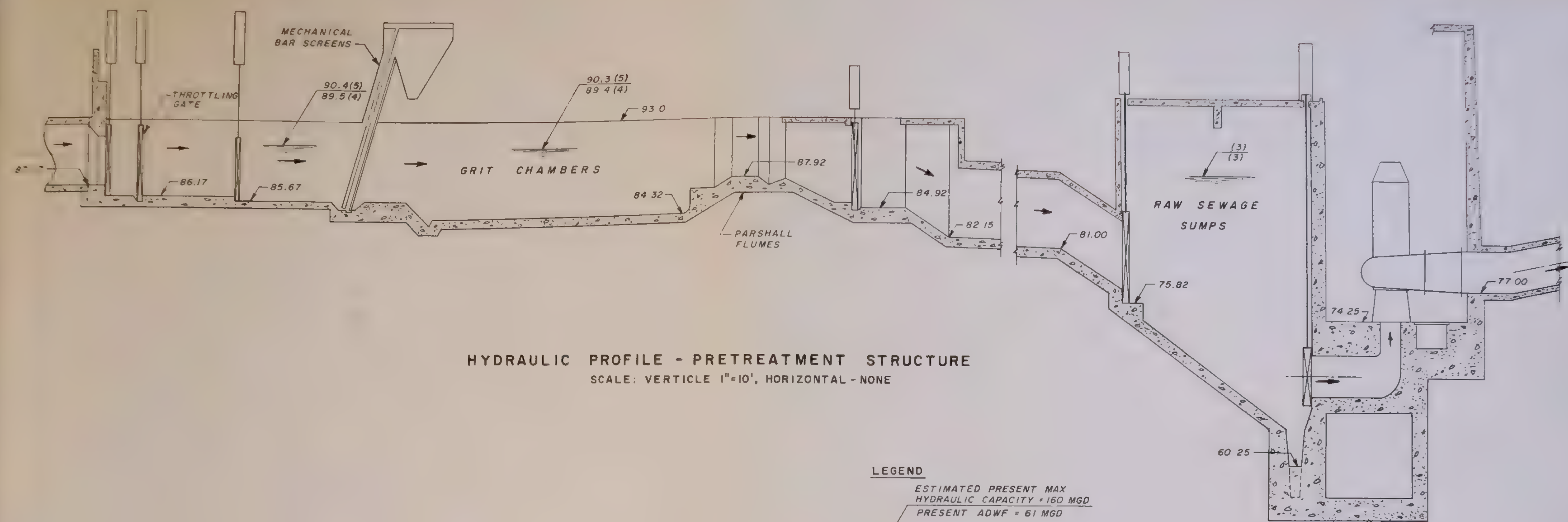
FILE F-265 E
DATE DEC 1970

CITY AND COUNTY OF SAN FRANCISCO
REPORT ON WATER POLLUTION CONTROL PLANTS

NORTH POINT PLANT
FLOW DIAGRAM

Fig. 2-2


MECHA
BAR SCR
THROTTLING
GATE
(3)
(3)
87.17
86.17
85.67
SEWAGE
SUMPS
2
77.00
74.25
60.25
DATUM NOTE: PROFILE LEVEL 100.0
EQUALS CITY'S DATUM 0.0
NOTES
(1) AT MEAN HIGHER HIGH WATER
(2) AT MEAN LOWER LOW WATER
(3) CONTROLLED W.S. ELEVATION VARIES
BETWEEN 84 AND 92
(4) THREE TANKS IN SERVICE
(5) FOUR TANKS IN SERVICE
105.2
105.1
RECEIVING
STRUCTURE
DISTRIBUTION
CHANNEL
100.80
FORCE MAINS
OUTFALL
88.00
DRAWN
CHECKED
DESIGNED
SUBMITTED
APPROVED
APPROVED
NORTH POINT PLANT
DRAULIC PROFILES
SHEET NUMBER
OF
DRAWING NUMBER
Fig. 2-3



HYDRAULIC PROFILE - PRETREATMENT STRUCTURE

SCALE: VERTICLE 1"=10', HORIZONTAL - NONE

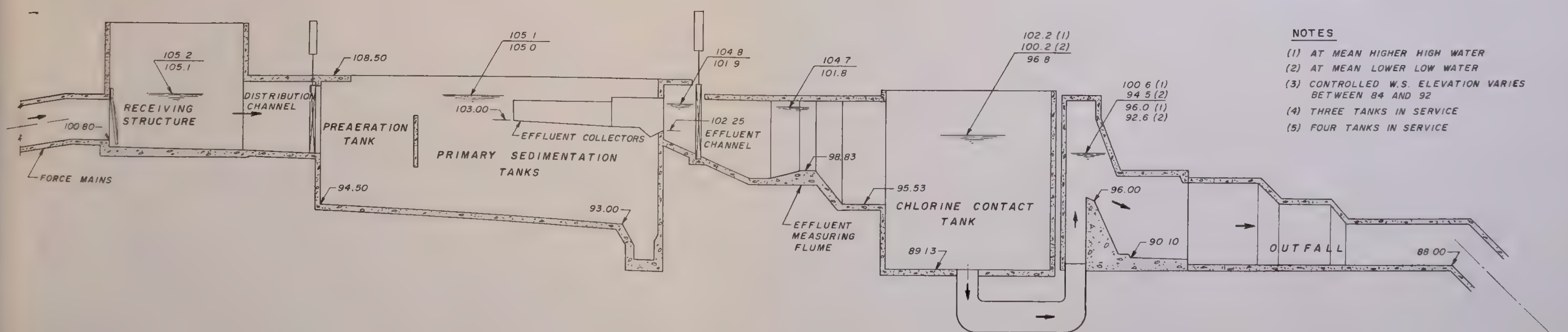
LEGEND

ESTIMATED PRESENT MAX
HYDRAULIC CAPACITY = 160 MGD
PRESENT ADWF = 61 MGD

DATUM NOTE: PROFILE LEVEL 100.0
EQUALS CITY'S DATUM 0.0

NOTES

(1) AT MEAN HIGHER HIGH WATER
(2) AT MEAN LOWER LOW WATER
(3) CONTROLLED W.S. ELEVATION VARIES BETWEEN 84 AND 92
(4) THREE TANKS IN SERVICE
(5) FOUR TANKS IN SERVICE



HYDRAULIC PROFILE - PRIMARY TREATMENT

SCALE: VERTICAL 1"=10', HORIZONTAL - NONE

DRAWN E.B. CHECKED	DESIGNED SUBMITTED	APPROVED 12/3/70 Date APPROVED Date	BROWN AND CALDWELL CONSULTING ENGINEERS SAN FRANCISCO - ALHAMBRA, CALIFORNIA	FILE F-265E DATE DEC 1970	CITY AND COUNTY OF SAN FRANCISCO REPORT ON WATER POLLUTION CONTROL PLANTS	NORTH POINT PLANT HYDRAULIC PROFILES	SHEET NUMBER OF	DRAWING NUMBER Fig. 2-3

TO HALF SIZE

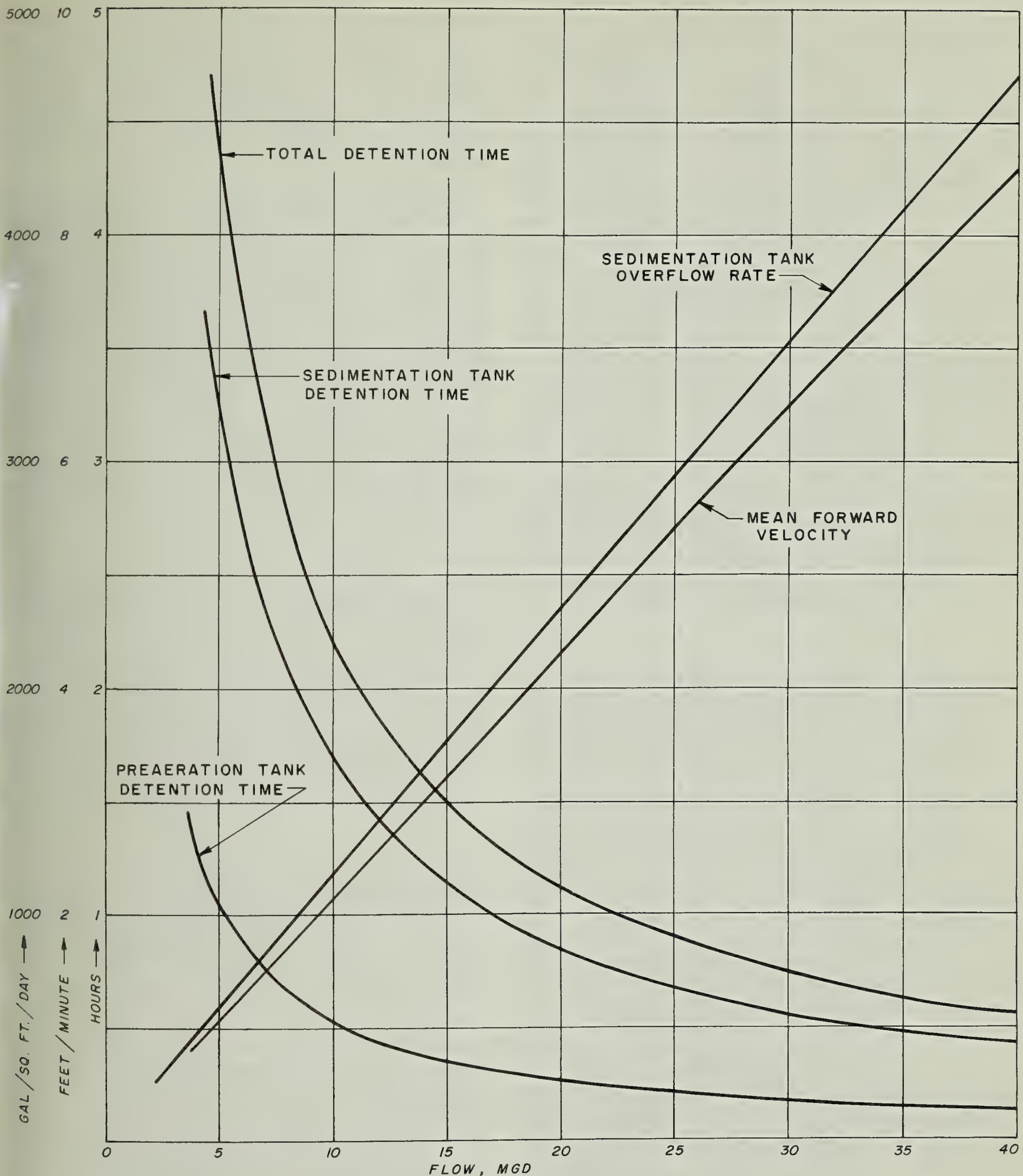


Fig. 2-4 Preaeration-Sedimentation Tank Parameters - North Point Plant

The first 74 ft of each tank is provided with four longitudinal rows of air diffusion plates for preaeration of the incoming sewage prior to sedimentation. At design flow conditions the detention time in this section of the tank is approximately 30 minutes. Compressed air is supplied by five positive displacement blowers rated at 870 cfm each. Blowers are located in a room at the preaeration

and sedimentation building No. 1.

Effluent sewage is collected from each primary sedimentation tank through four metal troughs provided with 90 degree V-notch weirs on both sides. Each trough has a weir length of approximately 138 ft and extends approximately 86 ft toward the influent end of the tank.

Each tank is equipped with two longitudinal sludge collectors and a cross collector for sludge removal. All are of the continuous chain and flight type. Longitudinal collectors run the entire length of the preaeration-sedimentation tanks. The longitudinal collectors transport settled sludge to the effluent end of the tank where a cross collector moves it to a 5-ft square collection hopper. The raw sludge pump takes its suction from the hopper. Both longitudinal and cross collectors run continuously when a preaeration-sedimentation tank is in service. Scum which accumulates on the water surface of the sedimentation portion of each tank is moved by water sprays to skimming troughs located between the preaeration and sedimentation section of each tank. Skimming troughs are of the tipping trough type and are manually operated.

Under normal conditions, all six tanks are in operation. About once a year each tank is taken out of service for maintenance and repair.

Chlorination. Chlorination facilities provide for prechlorination of influent sewage for odor control and hydrogen sulfide suppression and for postchlorination of plant effluent for disinfection.

These facilities include three hot water type evaporators and three V-notch chlorinators each with a capacity of 8,000 lb per day. Evaporators and chlorinators are piped to operate as integral units. All facilities are housed in the second floor of the pretreatment building. Any evaporator-chlorinator unit can be used for either pre or postchlorination. Chlorine is transported in solution from the chlorinators to the point of application. Liquid chlorine storage is provided by two 50 ton tanks located just outside the pretreatment building. Liquid chlorine is delivered by railroad tank car to a special siding within the plant site.

Chlorine solution for prechlorination is applied through a rubber lined half-pipe diffuser to the raw sewage in a manhole of the influent sewer just upstream of the treatment plant. The rate of chlorine application is set at about 30 lb per mil gal and is controlled by a signal from the effluent meter.

Chlorine solution for postchlorination is applied in the effluent channel between the preaeration and sedimentation buildings and the postchlorination building through chlorine diffusers. Dosage varies between 70 and 90 lb per mil gal and is set to maintain a chlorine residual in the effluent of 2.8 to 3.8 mg/l.

Postchlorination contact time is provided in a 50-ft diameter tank sized for a contact period of 5 min at design flow. The chlorine contact tank is located in the chlorination building. Inlet to the tank is tangential and the discharge is through an 8-ft diameter opening located at the center. Three columns located within the tank reduce the effect of the vortex which forms at the discharge opening.

Effluent Disposal. Plant effluent is measured in a 6-ft throat Palmer-Bowlus flume located in the effluent channel just upstream of the chlorine contact tank. Turbulence through the flume thoroughly mixes chlorine with the effluent. From the chlorine contact tank the plant effluent flows over a 14-ft wide weir into an 8-ft reinforced concrete outfall sewer. This line branches into two 6-ft concrete pipes. Each 6-ft line in turn branches into two 48-in. cast iron outfalls. These four lines discharge the effluent into San Francisco Bay approximately 10 ft below mean lower low water. Two outfalls are suspended under Pier 33 and two under Pier 35. All outfalls end in a 45 degree elbow about 800 ft offshore.

Solids Treatment

The North Point plant does not include facilities for the treatment and disposal of any of the solids removed during the sewage treatment process. Sludge and scum removed in the primary sedimentation tanks are pumped six miles through a 10-in. diameter force main to the Southeast plant. At the present time the average flow of sludge pumped from the North Point plant to the Southeast plant is approximately 850,000 gpd at a solids concentration of about one percent.

Sludge and Scum Removal. Raw sludge is removed from the sedimentation tanks by six centrifugal pumps. Each raw sludge pump transfers the sludge from the sedimentation tank collection hopper to one of two sumps located at the effluent end of the preaeration and sedimentation buildings.

Each raw sludge pump was originally rated at 300 gpm and driven by a variable speed driver. At present, each pump is run only at constant speed. Pumps have their own independent discharge pipeline to the sumps and each pipeline is provided with a Venturi flow meter.

Raw sludge pump operation is sequential and is manually controlled from the sludge control center. During normal operation, two raw sludge pumping units run simultaneously. When the operator observes that the sludge is thinning out, he switches to the next two units. Occasionally, depending on raw sludge concentrations, a third unit is put on line. When this occurs, the output of the three units exceeds the capacity of the disposal

pump and sludge overflows from the transfer sumps to the influent sewer through a 16-in. overflow pipe.

Scum skimming troughs in the three sedimentation tanks in each sedimentation building are interconnected. Scum collected in the troughs is flushed with No. 3 water to a sump located between the sedimentation buildings. The skimming troughs can be isolated by closing a slide gate at the sumps. A scum pumping unit, rated at 300 gpm, is provided at each sump. Scum from the sumps is pumped directly to the suction line of the sludge disposal pump which is in service. The scum removal operation is performed manually and independently of raw sludge pumping operation. When the scum pumps are discharging into the sludge disposal pump, its sludge pumping capacity decreases and the sludge sump level raises.

Solids Disposal. Sludge and scum are pumped to the Southeast plant by two dual speed sludge disposal pumps. Originally rated at 1000/700 gpm, they were recently replaced by units having capacities of 1050/600 gpm. The pumps take suction from the sludge sumps and are interconnected so each can pump from either sump. A Venturi type flow meter is provided in the common discharge line from the pumps.

Under normal operation, one disposal pump runs continuously at low speed unless there is an obstruction in the 10-in. force main. The pump is speeded up when it is necessary to clear the line. Once a week, usually on Monday morning, a cleaning tool is inserted in the force main and the pump runs at high speed until the tool is recovered at the Southeast plant end of the line.

Supplemental Facilities

In addition to the treatment process described in the preceding pages, the North Point plant is provided with separate administration and maintenance buildings. Secondary systems include ventilation, power and control, water, and steam cleaning.

Administration. The ground floor of the administration building includes space for the offices of the superintendent, chief engineer and chief chemist, a chemical and bacteriological laboratory, a sample preparation room, a laboratory storage room, a main control room, an electrical station, a secretary and reception area, a lunch room, washrooms and miscellaneous utility rooms. The second floor provides space for heating and ventilating equipment and additional storage space. The basement floor, which can also be considered a part of the influent pumping station, houses a boiler room, storage and repair areas, locker and shower rooms, and various utility rooms.

Maintenance. A separate maintenance building provides space for a machine shop for heavy repair work, a parts storage room, and a garage for plant vehicles. This building also houses the concrete storage tanks for the No. 1 and No. 2 water systems. Two No. 1 water booster pumps and a hydropneumatic tank are also located here.

Ventilation. With the exception of the maintenance building, every area in the treatment plant is provided with a system of mechanical ventilation. In general, air is supplied both by intake fans and by gravity and is exhausted by exhaust fans. Ventilated areas are kept under a slight negative pressure. Air is supplied and exhausted within the same building with no air transfer from one area to another for reuse. Central heating is provided only in the administration building. Ventilation fans run continuously and the two-speed units are all operated at high speed. A masking agent for odor control is fed to the exhaust air system in the headworks area, raw sewage sumps and sludge sumps area. Severe condensation occurs during the winter months in the preaeration and sedimentation buildings.

Power and Control. Power is supplied by Pacific Gas and Electric Company. There is no source of emergency power and, as a consequence, the treatment plant has to be shut down in the event of a power failure.

Control of the treatment process is performed from three control centers located in the pretreatment building, administration building and sludge control area. Station No. 1 in the pretreatment structure controls the operation of the main and throttling gates, fine screens, and grit tanks. Raw sewage, grit, scum and drainage pumps in the influent pumping station are all controlled from station No. 2 in the administration building. Preaeration blowers, sludge collectors and raw sludge and sludge disposal pumps are controlled from Station No. 3 located in the sludge control center.

Indicators and recorders for the monitored processes are housed in the control centers. All treatment process operation, with the exception of chlorination, is manually initiated from these stations.

Water. Water for plant washdown, pump gland seal, and hydraulically actuated gates except the inlet shutoff and throttling gates is supplied by a low pressure No. 2 water system. This system consists of two reinforced concrete storage tanks located in the maintenance building and three

booster pumps located in the pretreatment structure. The tanks are fed from a city's water supply main through an air gap which acts as a backflow preventer. The three booster pumps take suction from the tanks through a 10-in. line several hundred feet long. The inlet shutoff and throttling gates are supplied by a high pressure No. 2 water system which consists of two booster pumps and a hydropneumatic tank.

A No. 3 water system provides water for scum skimming in the sedimentation tanks, for grit flushing and sump agitation at the grit removal area, and for chlorine injector operation. To supply water to the system, plant effluent is pumped by three low pressure pumps to two 60-in. diameter rotating drum strainers located in the sludge control area of the sedimentation buildings. The drum filter media is fabricated of No. 40 mesh. Each rotating drum strainer is rated at 5,000 gpm. No. 3 water from the strainers flows by gravity to the scum sprays and to the grit sluice trough and sumps. No. 3 water for chlorine injection is pumped to the chlorinators by three high pressure pumps.

Water for drinking and other domestic uses is supplied by a No. 1 water system. This system consists of a reinforced concrete tank, two booster pumps and a hydropneumatic tank, all located in the maintenance building.

Steam Cleaning. There are five steam cleaners located in the pretreatment, administration, preaeration and sedimentation buildings and sludge control area. The units are identical and can supply either steam or high pressure hot or cold water. The steam cleaning units are connected to piping systems that distribute steam and high pressure hot or cold water throughout the plant.

Treatment Plant Personnel

The North Point plant has an operation and maintenance staff of 33. The plant is attended 24 hr a day. Table 2-2 lists the classes and numbers of personnel employed at the North Point plant during the 1969-1970 fiscal year.

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

The Richmond-Sunset Water Pollution Control Plant was completed in 1939 at a project cost of $2,000,000 with a design peak wet weather flow (PWWF) capacity of 45 mgd. It has since been enlarged and modified to its present design PWWF capacity of 70 mgd. The plant is located in the southwest corner of the Golden Gate Park, which provides good isolation from the nearby residential areas. The treatment plant serves a tributary area of about 10,600 acres, the development of which is almost entirely residential.

Table 2-2 Class and Number of Operating Personnel - North Point Plant

Class title	Number
Sewage treatment plant superintendent	1
Chief stationary engineer	1
Senior sewage treatment chemist	1
Sewage treatment chemist	2
Senior clerk typist	1
Senior stationary engineer	6
Stationary engineer	15
Truck driver	1
Janitor	1
General laborer	4
Total	33

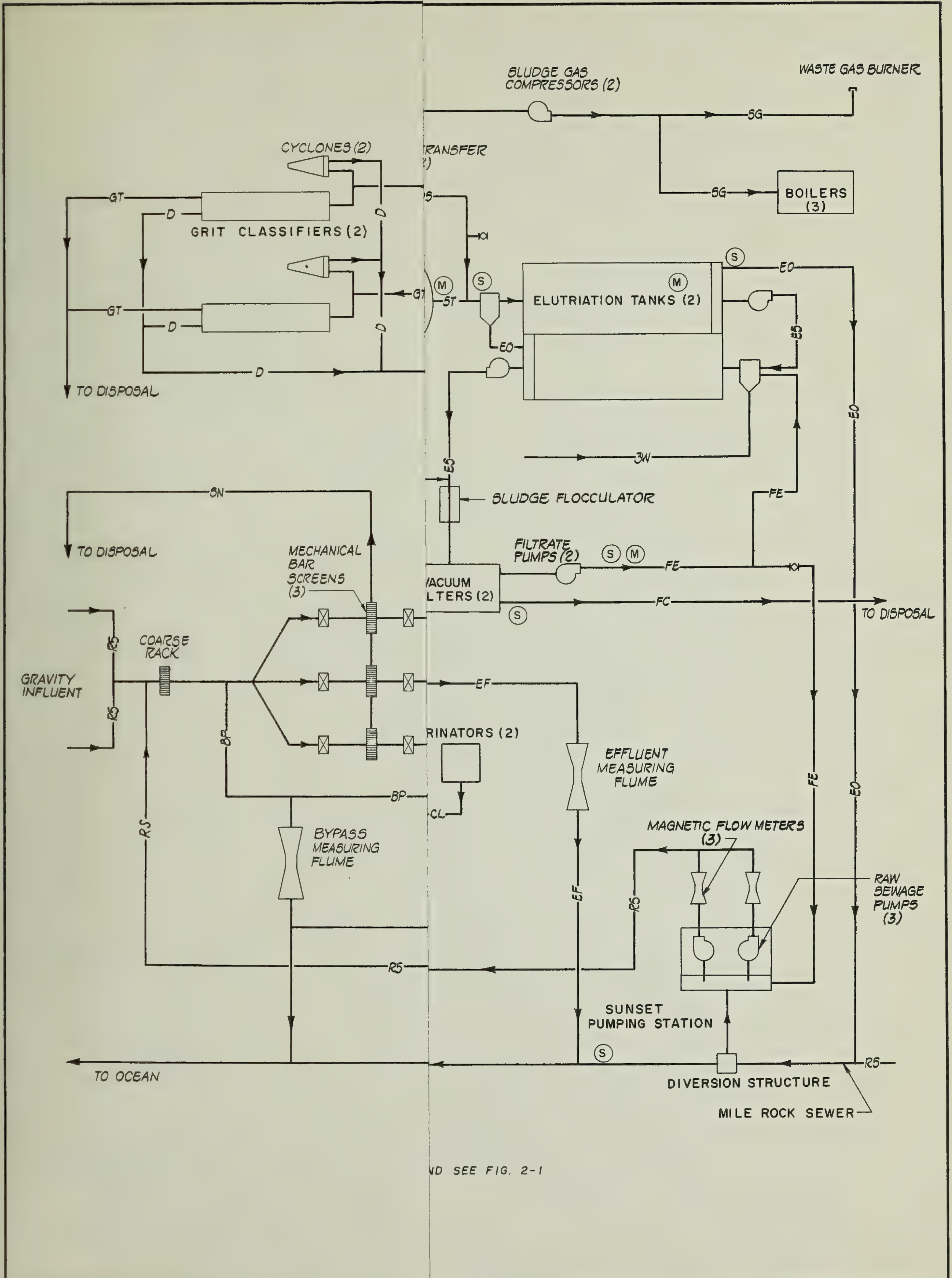
About 60 percent of the total flow to the plant arrives by gravity through two main interceptors. The remainder is pumped from the Mile Rock interceptor sewer by the Sunset pumping station to a receiving structure upstream of the plant overflow weir.

Sewage Treatment

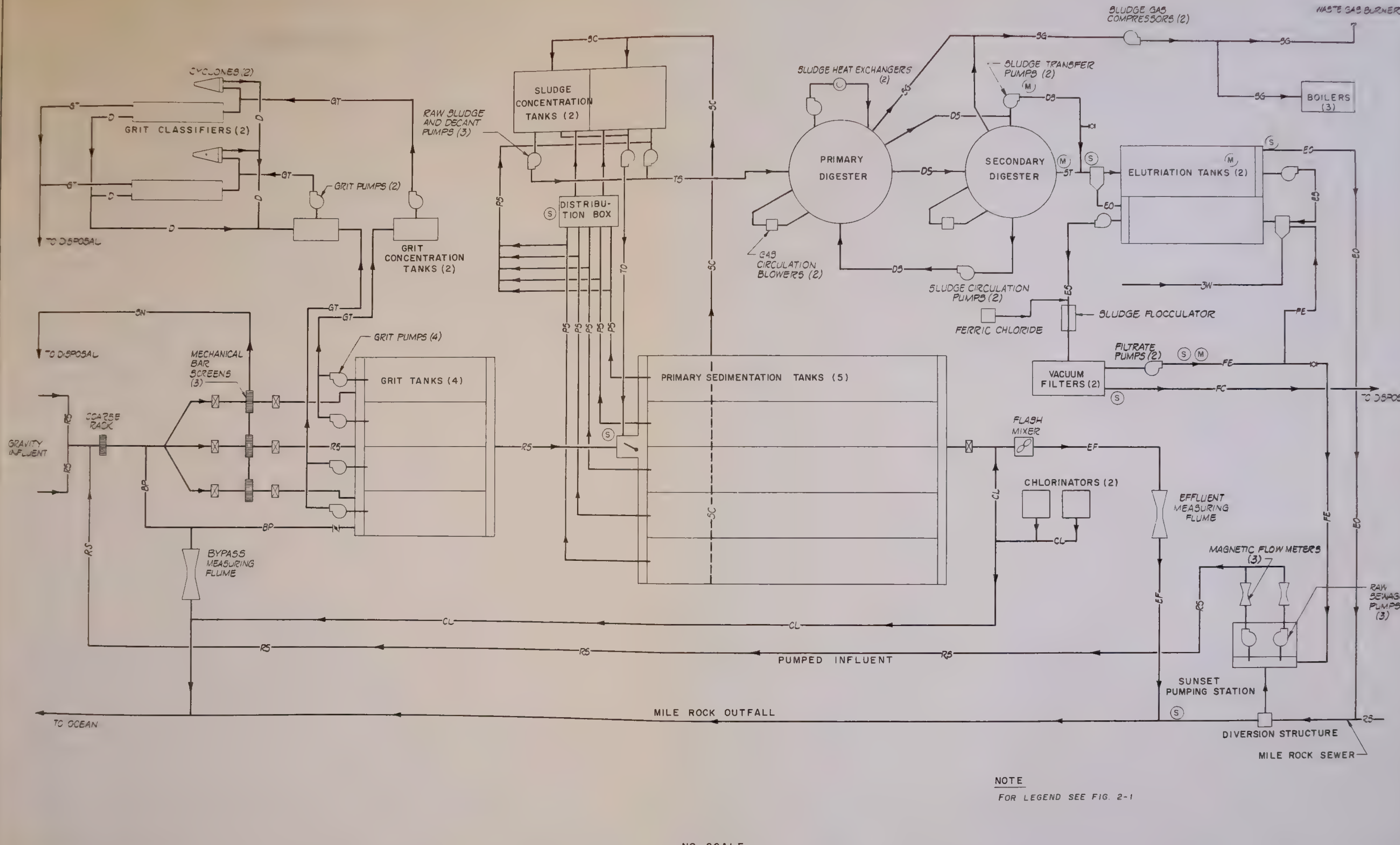
The plant provides conventional primary treatment consisting of screening, grit removal, primary sedimentation and effluent disinfection prior to its discharge to the ocean. Solids separated during settling are subjected to two-stage digestion, sludge conditioning and dewatering before disposal as a soil filler within the park. All the treatment units are housed in four buildings: pretreatment, sedimentation, administration and digester buildings.

A flow diagram of the treatment units and their functions is presented on Fig. 2-5 while process and equipment data are given in Table 2-3. Fig. 2-6 shows hydraulic profiles for the flow conditions of present average dry weather flow and estimated maximum hydraulic capacity.

Sunset Pumping Station. The Sunset pumping station is incorporated into the treatment plant administration building. Incoming flow to the station is diverted from the 9 by 11-ft Mile Rock sewer through a 3.5-ft wide channel fitted with coarse bar racks. After passing through the bar racks, the flow enters a minimum sized receiving well. Modified and enlarged in 1964, the station contains three identical motor-driven variable speed centrifugal pumps and has a maximum capacity of 33 mgd. Each pump discharge is carried through a separate 20-in. force main to the plant headworks



DRAWN D.S. Aspinall CHECKED	DESIGNED SUBMITTED	APPROVED APPROVED	CHMOND - SUNSET PLANT FLOW DIAGRAM	SHEET NUMBER ___ OF ___
				DRAWING NUMBER Fig. 2-5



BROWN AND CALDWELL
CONSULTING ENGINEERS
SAN FRANCISCO - ALHAMBRA, CALIFORNIA

FILE F-265E
DATE DEC 1970

CITY AND COUNTY OF SAN FRANCISCO
REPORT ON WATER POLLUTION CONTROL PLANTS

RICHMOND - SUNSET PLANT
FLOW DIAGRAM

Fig. 2-5

Table 2-3 Process and Equipment Data - Richmond - Sunset Plant

	Design[a]	Present[b]
SEWAGE TREATMENT		
Basic Data		
Population, 1,000's	300	-
Total flow, mgd		
Minimum dry weather, (min/avg/max)	-/-/-	7.5/7.9/9.0[c]
Average dry weather, (min/avg/max)	-/15/-	19/20/21[c]
Peak dry weather, (min/avg/max)	-/-/-	28/30/33[c]
Peak wet weather, (min/avg/max)	-/45/-	-/35/46[d]
Maximum hydraulic capacity	-	70
Loadings, 1,000 lbs/day		
Suspended solids, (min/avg/max)	-/-/-	46/54/67[c,e]
5-day, 20°C, BOD, (min/avg/max)	-/-/-	22/30/39[c,e]
Sunset pumping station		
Influent pumps		
Number	4	3
Capacity, mgd/pump	-	11
Screenings		
Coarse rack		
Number	-	1
Channel width, feet	-	6
Bar thickness, inches	-	1/2
Clear spacing between bars, inches	-	3-1/2
Influent gates		
Number	2	3
Size, feet	4 x 3	3 x 4
Screen sluice gates		
Number	-	3
Size, feet	-	2.5 x 4
Influent conduits		
Number	2	3
Size, feet	5 x 3.5	3
Mechanically cleaned bar screens		
Number	2	3
Channel width, feet	6	5
Bar thickness, inches	3/8	3/8
Clear spacing between bars, inches	3/4	3/4
Screenings removed		
Average, cu ft/ mil gal	-	3.6[d]
Maximum day, cu ft	-	143[d]
Grit Removal		
Grit tanks		
Number	4	4
Length, feet	48	48
Width at water surface, feet	9.9	9.9
Depth, feet	10	10
Grit pumps		
Number	2	6
Capacity, gpm/pump	200	2 @ 300 4 @ 200
Grit cyclone-classifiers		
Number	1	2
Capacity, gpm	-	300
Grit removal		
Average, cu ft/mil gal	-	4.5[d]
Maximum day, cu ft	-	343[d]

Continued on next page

Table 2-3 Process and Equipment Data - Richmond - Sunset Plant (Continued)

	Design[a]	Present[b]
Primary Sedimentation		
Flocculation tanks		
Number	4	-
Length, feet	33.5	-
Width, feet	33.5	-
Depth, feet	10	-
Grit removal blowers		
Number	3	3
Capacity, cfm/blower	410	410
Primary Sedimentation Tanks		
Number	4	5
Length, feet	100	133.5
Width, feet	35.5	35.5
Average water depth, feet	9.5	9.5
Detention time, hours, all tanks operating, average dry weather flow (15,20 mgd)	1.5	2.1
Overflow rate, gal/sq ft/day, all tanks operating, average dry weather flow (15,20 mgd)	1,120	850
Mean forward velocity, ft/min, all tanks operating, average dry weather flow (15,20 mgd)	2.0	1.0
Chlorination		
Chlorine storage		
Number of cylinders, maximum	18	24
Capacity, tons/cylinder	1	1
Evaporators		
Number	2	3
Capacity, lbs/day total	4,000	8,000
Chlorinators		
Number	3	2
Capacity, lbs/day total	4,000	8,000
Rates		
Prechlorination, lb/mil gal	30	-
Postchlorination, lb/mil gal	100	110
Effluent Disposal		
Outfall sewer		
Length, feet	7,000	7,000
Size, feet	9 x 11	9 x 11
SOLIDS TREATMENT		
Sludge and Scum Removal		
Raw sludge and scum pumps		
Number	2	2
Capacity, gpm/pump	400	400
Decant pumps		
Number	2	1
Capacity, gpm/pump	400	800
Scum removal equipment		
Number	2	5
Type	Tipping trough	Rotary blades
Solids Digestion		
Primary digester		
Internal diameter, feet	100	100
Side water depth, feet	42	42
Volume, 1,000 cu ft	283	283
Secondary digester		
Internal diameter, feet	80	80
Side water depth, feet	28	28
Volume, 1,000 cu ft	140	140

Continued on next page

Table 2-3 Process and Equipment Data - Richmond - Sunset Plant (Continued)

	Design	Present
Solids digestion (continued)		
Digester loadings[c]		
Loading, 1,000 lb dry solids/day	-	20[d]
Loading, lb dry solids/cu ft/day	-	0.04
Detention time, days	-	32
Assumed volatile solids, percent	-	84[e]
Assumed volatile solids, destroyed percent	-	70[e]
Volatile solids, destroyed 1,000 lbs/day	-	12[d,e]
Sewer gas		
Assumed gas production, cu ft/lb of volatile matter destroyed	-	16[d,e]
Gas production, 1,000 cu ft/day	-	184
Waste gas burners		
Number	1	1
Gas circulation blowers		
Number	-	2
Capacity, cfm/blower	-	125
Gas compressors		
Number	2	2
Capacity, cfm/blower	115 & 75	115 & 75
Sludge heaters		
Number	-	2
Capacity, million btu/hr/heater	-	1.65
Sludge circulation and transfer pumps		
Number	2	5
Capacity, gpm/pump	100	3 @ 300 2 @ 100
Solids Conditioning and Disposal		
Elutriation		
Tanks		
Number	2	2
Length, feet	50.5	50.5
Width, feet	14.7	14.7
Average depth, feet	9	9
Transfer pumps		
Number	2	3
Capacity, gpm/pump	100	100
Filtration		
Filters		
Number	1	2
Diameter, feet	8	8
Length, feet	8	8
Percent solids filter cake	-	25[e]
Storage bins		
Number	5	4
Capacity, total cu ft	990	800
SUPPLEMENTAL FACILITIES		
Ventilation system		
Sludge control room		
Exhaust fans		
Number	1	2
Capacity, 1,000 cfm/fan	2.8	2.8
Digester operation building		
Exhaust fans		
Number	1	1
Capacity, 1,000 cfm/fan	2.7	2.7

(continued on next page)

Table 2-3 Process and Equipment Data - Richmond-Sunset Plant (Continued)

	Design	Present
Ventilation system (continued)		
Elutriation tanks area		
Exhaust fans		
Number	1	1
Capacity, 1,000 cfm/fan	3	6
Utilities		
No. 1 water system pumps		
Number	2	2
Capacity, gpm/pump	30	30
No. 2 water system pumps		
Number	2	2
Capacity, gpm/pump	450	450
No. 3 water system pumps		
Number	2	3
Capacity, gpm/pump	450	250
Steam cleaners		
Number	-	1
Capacity, lb/hr/cleaner	-	60-70
Plant heating system		
Boilers		
Number	2	3
Condensate pumps		
Number	2	3
Capacity, gpm/pump	25	25
Hot water circulation pumps		
Number	2	3
Capacity, gpm/pump	100	100

[a] Data represents information developed from original initial construction drawings and information supplied by paper entitled "Municipal Sewage and Waste Treatment - Treatment Plants" as prepared by the Sewage and Waste Division of the Bureau of Sewer Repair and Sewage Treatment in 1958.

[b] Unless otherwise noted, data represents actual field observations, office calculations and information obtained from City engineering and plant personnel.

[c] Based on flow measurements taken during 7-day sampling.

[d] From "Summary of Treatment Plant Operation", 1968-69.

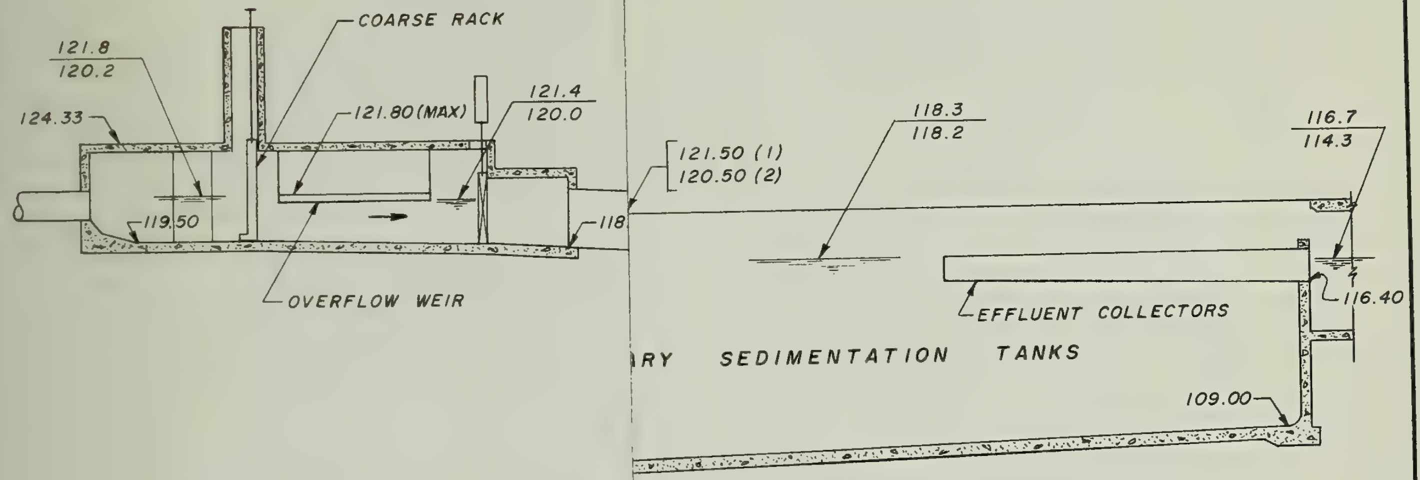
[e] Based on 7-day sampling program results.

and each line is provided with a 14-in. magnetic flow meter. The three pumps are situated in a 7,200 sq ft dry well located approximately 33 ft below ground level. Motor and variable speed drives are situated in the motor and pump control room approximately 17 ft below ground level. Access to the receiving well operating level, where the influent sluice gate and coarse bar racks are located, is through a watertight door from this room. The hydraulic power unit for controlling the sluice gate is located in the receiving well.

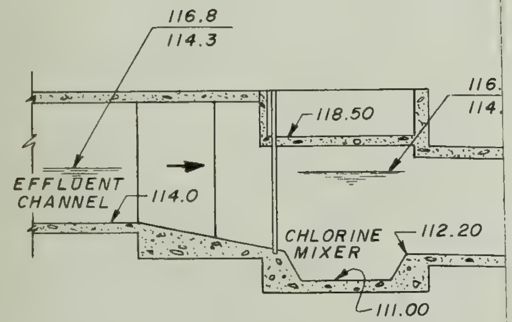
Pump operation is automatically controlled by variations of sewage level in the sump as sensed and transmitted by means of a bubbler system. Pumps are programmed to start in sequence. The lead pump starts at minimum speed and increases its speed as the sump level rises until it reaches its maximum speed. If the sump depth continues to increase, a second pump starts and the two pumps operate at approximately the same pumping speed. In the event of a continuously rising water surface elevation, the third unit starts and the operation sequence repeats itself. Provisions are incorporated in the controls to throttle and finally close the influent sluice gate when the incoming flow exceeds the combined pumping capacity of the three units. The gate also shuts down during power failure.

Pumps shut down with decreasing levels in the sump in reverse order to start-up.

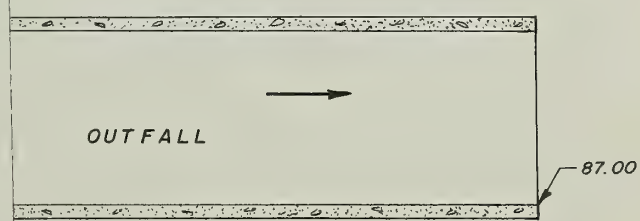
Emergency Bypass. The treatment plant capacity during wet weather is based on a rainfall intensity of 0.02 in. per hour. Storm flows in excess of this figure are bypassed to Pacific Ocean. Bypassing in the Richmond-Sunset plant takes place at two different locations: (1) the overflow weir of



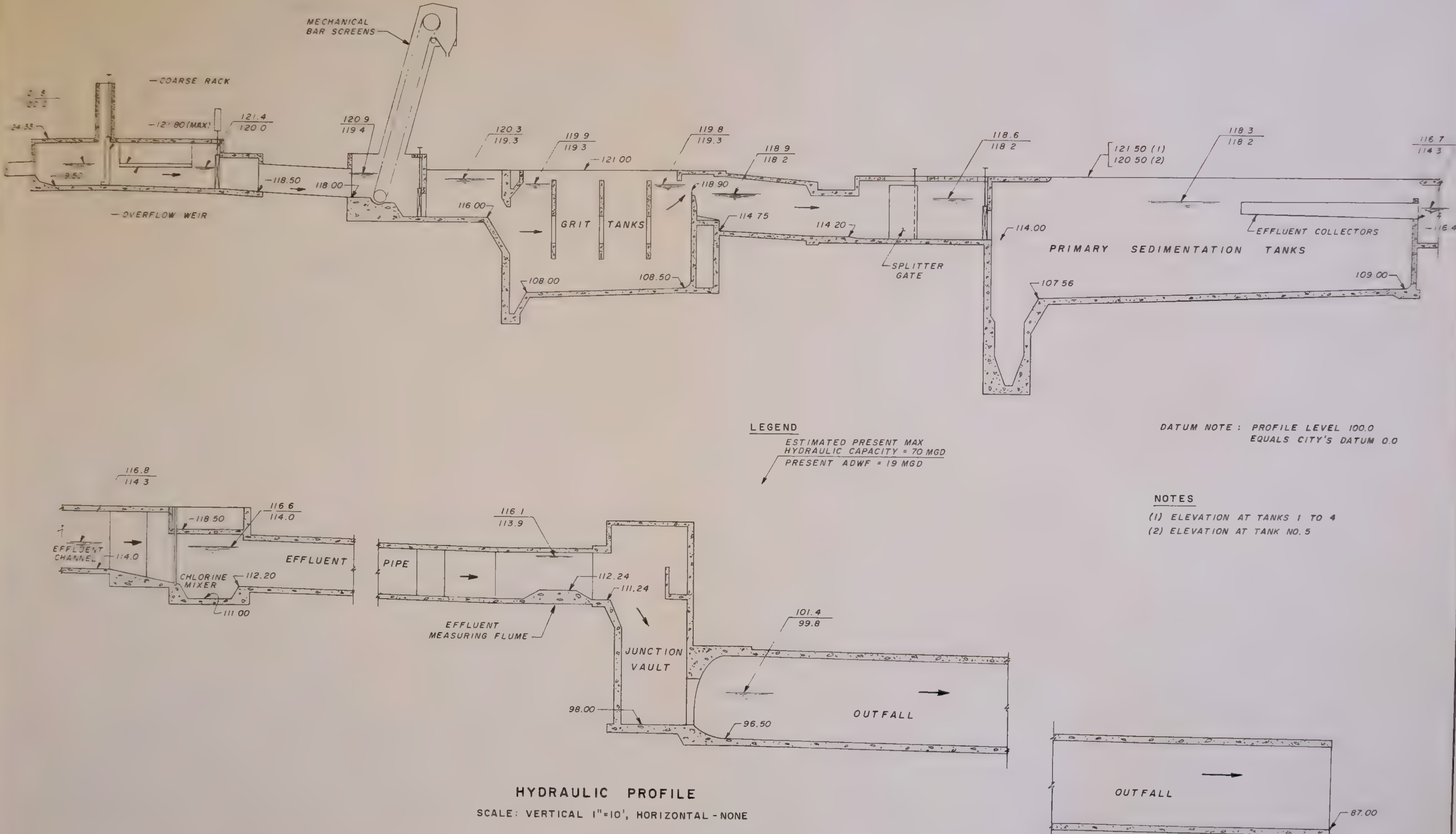
DATUM NOTE : PROFILE LEVEL 100.0
EQUALS CITY'S DATUM 0.0



NOTES
(1) ELEVATION AT TANKS 1 TO 4
(2) ELEVATION AT TANK NO. 5



DRAWN F. B.	DESIGNED	APPROVED	HMOND - SUNSET PLANT	SHEET NUMBER	DRAWING NUMBER
CHECKED	SUBMITTED	APPROVED	DRAULIC PROFILE	OF	Fig. 2-6



HYDRAULIC PROFILE

SCALE: VERTICAL 1"=10', HORIZONTAL - NONE

DRAWN	DESIGNED	APPROVED	BROWN AND CALDWELL CONSULTING ENGINEERS SAN FRANCISCO - ALHAMBRA, CALIFORNIA	FILE F-265E DATE DEC 1970	CITY AND COUNTY OF SAN FRANCISCO REPORT ON WATER POLLUTION CONTROL PLANTS	RICHMOND-SUNSET PLANT HYDRAULIC PROFILE
CHECKED	SUBMITTED	APPROVED			SHEET NUMBER ___ OF ___	DRAWING NUMBER Fig. 2-6

the Sunset pumping station diversion structure in the Mile Rock sewer (weir crest elevation 0.0 ft City of San Francisco datum) when the flow exceeds the station capacity or upon power failure and (2) the overflow weir in the plant headworks bypass structure (weir crest elevation 21.3 ft) when the flow exceeds plant capacity. The influent sluice gate to the Sunset pumping station is throttled during periods of bypassing at the Mile Rock sewer overflow weir. Throttling of the gate starts when the water surface elevation reaches the level of the overflow weir. Flows in excess of 33 mgd are bypassed to the Mile Rock outfall.

Bypassing at the headworks overflow weir takes place when the total flow through the plant reaches approximately 70 mgd. At this time raw sewage overflows into a 6.5-ft wide channel, passes through a 4-ft throat Parshall flume and enters a 54-in. diameter bypass line that connects to the Mile Rock outfall.

Provisions will be available to chlorinate the headworks bypassed sewage when the present reconstruction of this area is complete. The point of application of the chlorine solution will be immediately downstream from the measuring flume and the dosage will be varied in proportion to the flow. There are no facilities to chlorinate raw sewage bypassed at the pumping station diversion structure.

Screenings. Plant screenings facilities are presently being completely reconstructed as part of the remodeling of the pretreatment building. When present construction is completed, the plant will be provided with a 6-ft wide manually cleaned coarse bar rack situated a short distance from the junction on the influent sewers and force mains. After passing through the coarse rack the incoming sewage will flow through a 6 by 5-ft influent channel past the overflow weir in plant headworks bypass and then be divided into three 36-in. diameter influent pipes each terminating in a 5-ft wide bar screen channel. Each bar screen system will be provided with a 36 by 48-in. hydraulically operated inlet sluice gate, a 5-ft wide mechanically cleaned bar screen and a 48 by 30-in. hand operated outlet sluice gate.

Screenings retained on the automatic bar screen will be raked up to the roof of the pretreatment building and dumped on a belt conveyor. The conveyor will carry the screenings to a metal storage bin from which it will be hauled daily to the city dump.

At the time this study was made, two bar screen systems were operable. The third system was still under construction.

Grit Removal. After passing through the bar screens, sewage flows into a common channel from which it enters four grit tanks through inlet ports provided with butterfly gates. The grit tanks were originally designed as grit and scum removal units, but the scum system was eliminated when the treatment plant was expanded in 1946. Each tank is 48 ft long and 10 ft wide at the top, with one wall sloping at a 45 deg angle to form a V-shaped cross section. Tanks are divided into four compartments by transverse baffles that extend approximately two-thirds the depth of the grit chamber. Each compartment is provided with a row of air diffusers located along the vertical wall of the tank. Settled grit is moved to a hopper located at the inlet end of the chamber by continuous chain flights which travel along the entire length of the tank. Compressed air for the air diffusers is supplied by three positive displacement blowers.

The grit tanks have been slightly modified as part of the pretreatment building reconstruction project. These changes included new grit collectors and drives, new inlet butterfly gates, removal of a 5 by 3-ft portion in each transverse baffle, removal of a scum baffle at the tank's outlet end, and relocation of the aeration blowers. Also included is a 4-ft bypass channel that permits diversion of screened sewage to the 54-in. bypass line which connects to the Mile Rock outfall.

Degritted sewage leaves each tank by flowing over a full width weir. After passing over the weir it is once again collected into a common channel and moved by gravity towards the sedimentation building.

Grit Disposal. A new grit handling system has also been installed as part of the present pretreatment reconstruction. Under the new system, material collected in the grit tank hoppers is pumped by four 200 gpm pumps to two grit concentration tanks. From the concentration tanks grit is lifted by two 300 gpm pumps to two combination cyclone classifiers. Grit removed by these units is discharged into two storage bins. One of these bins is also used to store screenings. From the bins grit is hauled by truck to the city dump for disposal. Overflow from the cyclones and classifiers is returned to the grit concentration tanks. The new piping arrangement allows the grit tank pumps to discharge to either concentrantio tank and the cyclone-classifier units to operate in series or parallel in combination with either grit concentration tank.

Primary Sedimentation. Primary settling takes place in five rectangular tanks housed in the sedimentation building. The first four tanks are identical units and were originally built as combination flocculation-sedimentation basins. A fifth tank was added in 1963 and the other four converted to conventional sedimentation basins. At that time, floc-

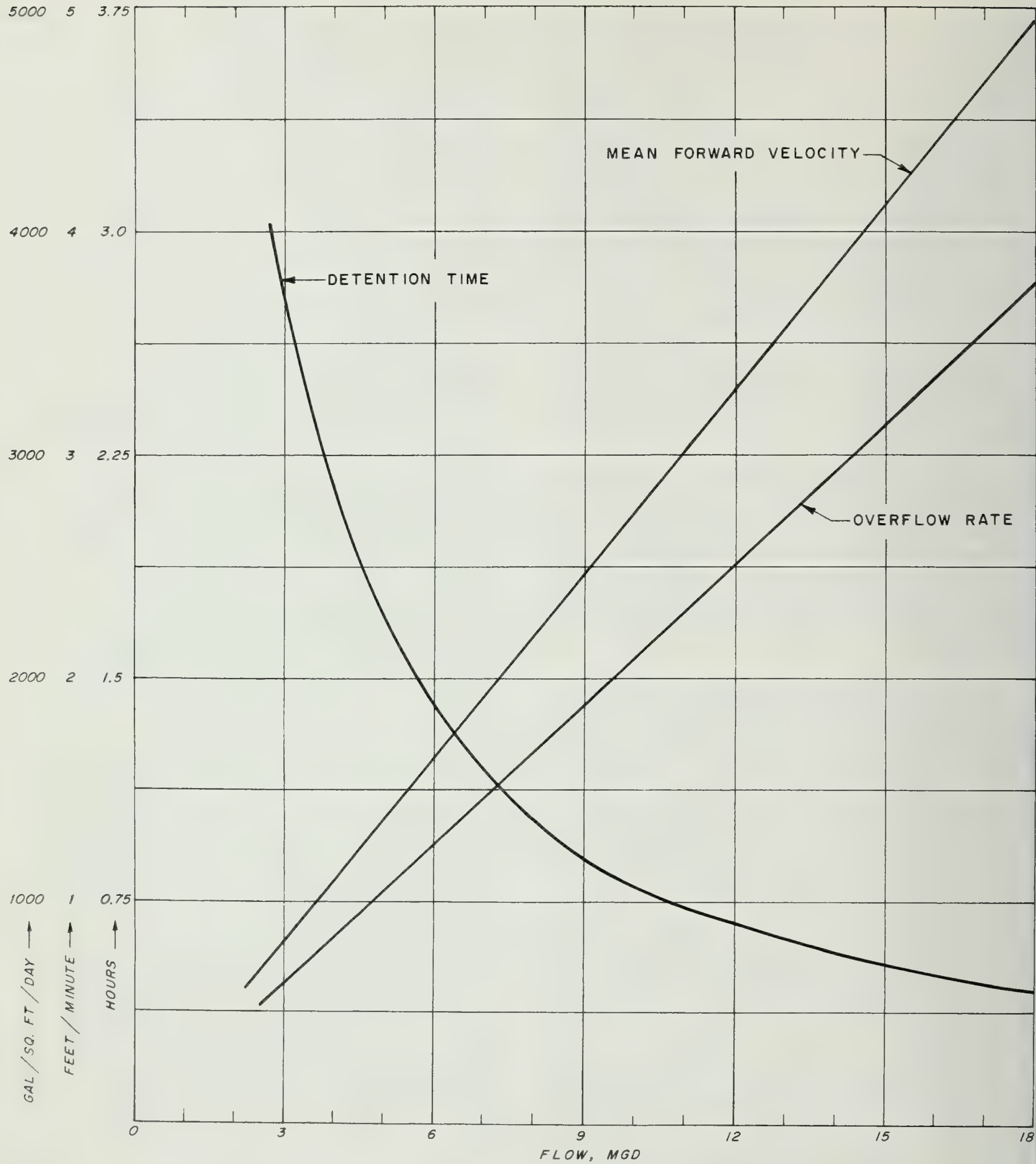


Fig. 2-7 Sedimentation Tank Parameters - Richmond-Sunset Plant

culation facilities were removed from the existing tanks. Each tank is now 135.5 by 33.5 ft with an average depth of 10 ft. Detention time at ADWF of 19 mgd is 2.1 hours. Fig. 2-7 shows detention time, overflow rate and mean forward velocity plotted against flow for each tank.

Just prior to entering the sedimentation building an adjustable splitter gate divides the incoming channel flow into two parts. The splitter is adjusted so that three-fifths of the flow goes to the east

battery of three tanks and two-fifths goes to the west battery of two tanks. Supernatant return from raw sludge thickening tanks is discharged upstream of the splitter gate. Automatic sampling takes place immediately upstream of the supernatant discharge. Incoming flow enters each sedimentation tank through one opening which is provided with an isolating gate and baffle.

Settled sewage is collected from each tank through four metal troughs provided with 90 deg V-notch weirs on both sides. Total weir length in each trough is approximately 83 ft and each trough extends about 43 ft toward the influent end of the tank.

Each of the four original tanks is equipped with two sets of double longitudinal sludge collectors and a single cross collector for sludge removal. The fifth tank has only one set of double longitudinal collectors and a cross-collector. The difference in arrangement is due to the fact that in the original four units the sludge hopper is located approximately 34 ft from the tank inlets between the original flocculation portion of the tank and the settling portion, while in the newer tank the hopper is situated directly next to the tank inlets. All sludge collectors are of the continuous chain and flight type. Longitudinal collectors run continuously, collecting and transporting settled sludge to the transverse valley wehre the cross-collector moves it to a small and deep hopper located at the side of the tank. From this hopper the sludge flows by gravity to the concentration tanks.

Scum which accumulates on the water surface is collected in scum troughs located upstream of the effluent launders. Each trough is equipped with rotating skimmers with two rubber blades. Scum is skimmed by the returning collector flights except in the first 34 ft of the older tanks, where water sprays are used for skimming. All rotating skimmers are electrically driven.

Under normal conditions, all five sedimentation tanks are kept in operation. Tanks are usually taken out of service once a year for routine inspection and maintenance. Sludge and scum lines are normally backflushed with No. 2 water once a shift.

Chlorination. Chlorination facilities are provided for disinfection of the plant effluent. When present reconstruction is completed, chlorination of raw sewage bypassed over the new headworks overflow weir will also be possible.

Present chlorination facilities include three hot water type evaporators and two V-notch chlorinators. Evaporators and chlorinators are rated at 8,000 lb per day. Chlorinators are presently fitted with 4,000 lb per day orifices. A chlorine storage area provides space for 24 one-ton cylinders. Chlorinators and associated equipment and controls are housed in the chlorine equipment room located at the outlet end of the sedimentation building. Evaporators, storage cylinders and related piping occupy a covered open platform adjacent to the chlorinator room.

Chlorine solution for effluent disinfection is applied through diffusers in a mixing chamber immediately upstream of the inlet to the 60-in. effluent line. The rate of chlorine application is presently controlled in response to variations in sewage flow and averages 110 lb per million gallons. A chlorine residual analyzer is installed in the chlorine equipment room but its performance and reliability as a control device has not been considered satisfactory by the plant supervisory personnel. A flash mixer is provided in the mixing chamber to mix the chlorine solution with the plant effluent. Chlorine contact time is provided by the 60-in. effluent line and Mile Rock outfall sewer. At the present average flow of 19 mgd, the contact period is approximately 50 minutes.

Effluent Disposal. Plant effluent is measured in a 5-ft wide critical depth flume located near the junction of the 60-in. effluent line and the Mile Rock outfall sewer. After flowing through the flume, effluent drops into a junction vault and enters the deep outfall sewer. The 9 by 11-ft outfall discharges into the Pacific Ocean at the shore line near the entrance to San Francisco Bay, approximately 7,000 ft north of the treatment plant.

Solids Treatment

As indicated previously, the Richmond-Sunset plant is provided with facilities for the treatment and disposal of all the solids removed during the sewage treatment process. Organic solids are first stabilized in anaerobic digestion tanks, then the digested sludge is conditioned by elutriation and coagulant addition, and finally it is dewatered by vacuum filtration and disposed of as a soil conditioner.

Sludge and Scum Removal. Raw sludge removed in the sedimentation tanks flows by gravity from the deep collection hopper to a large distribution box through separate 6-in. diameter cement lined pipelines. Normally, raw sludge is removed simultaneously from all sedimentation tanks at intervals that vary according to the sewage flow through the plant. Scum collected in the sedimentation tank scum troughs flows by gravity directly to the concentration tanks through two 6-in. diameter, glass lined pipes. This system is usually operated several times a day. From the distribution box, sludge is directed at the operator's discretion into one of two gravity-type concentration tanks. The concentration tanks are operated in sequence, with one tank being filled while sludge is being

withdrawn from the other. The tanks are 36.5 ft long by 10 ft wide by 15.5 ft deep and have a combined volume of 56,000 gallons. A 1.0 by 10-ft opening at the top of the dividing wall between the two concentration tanks provides an overflow interconnection. Both tanks are equipped with spray water nozzles at about half the tank depth and air diffuser nozzles near the bottom. The spray nozzles are used after a concentration tank is emptied to wash sludge deposits towards the pump suction line. The diffuser nozzles are not presently used. Sludge and scum removal pumps are housed at the bottom of a 420 sq ft by 9.5 ft deep room adjacent to the concentration tanks. A control room directly above the tanks and the pump room houses the motor control and operation center, an exhaust fan, and the large distribution box where the sludge lines from all sedimentation tanks end. Two mud valves at the box bottom direct the incoming sludge to either one of the concentration tanks.

Solids Pumping to Digesters. Sludge from the concentration tanks is pumped through one of two 5-in. lines to the digestion tanks. The three centrifugal sludge and scum removal pumps are interconnected so they can take suction from either tank and can perform any function. Two are used to pump concentrated sludge to the digesters while the third unit returns the supernatant liquid to the plant flow ahead of the sedimentation building. The two systems are never operated simultaneously. A normal tank pump-down cycle consists of an initial period of pumping sludge to the digesters, an intermediate period of supernatant pumping and a final period of sludge pumping. The lengths of all pumping periods are manually controlled by the shift operator who monitors the condition of the sludge with grab samples and the pumped volume by the elevation of the stem rod of a large tank level float. The two units pumping to the digesters are normally operated in series to overcome the high head losses in the force main to the digesters. At the present time the average raw sludge flow to the digesters is approximately 100,000 gal per day at a solids concentration of about 2.0 - 2.5 percent.

Solids Digestion. Anaerobic sludge digestion takes place in two digesters with a combined volume of approximately 3,200,000 gallons. One tank is 100 ft in diameter with a fixed cover and the other is 80 ft in diameter with a gas holding cover. Both digesters are provided with external heat exchangers for sludge heating and with compressed gas diffusers for mixing of their contents. The digester control building, located between the digestion tanks, houses three sludge circulating pumps, two digested sludge pumps, two heat exchangers, two sludge gas compressors with their accessory equipment and both digester overflow boxes.

Digesters are normally operated as two-stage digesters with the larger tank acting as the primary digester and the smaller as the secondary. Raw sludge is pumped intermittently into the primary tank at two points which are alternated daily. Both tanks are maintained full, so when sludge is added there is an automatic transfer of primary sludge into the secondary digester and of secondary supernatant into the elutriation tanks. Sludge from the primary digester is continually circulated through the heat exchangers and the temperature maintained at about 95°F. Normally, the circulating pump draws sludge from only the intermediate level through sampling lines on the control building side of the digester and returns the heated sludge at the top. The tank contents of the primary digester are continuously mixed with compressed sludge gas fed through diffusers located at the tank bottom.

In the secondary digestion tank, transferred primary sludge is allowed to stratify, and, with the exception of a periodic stir-up of the tank contents, the digester is not mixed. Secondary sludge is pumped to the primary tank every day for a short period of time to maintain the desired level of buffering akalinity in the primary digester. Digested sludge is withdrawn from the bottom of both tanks daily and pumped to the elutriation system. Digested sludge withdrawal pump operation is manually controlled to maintain maximum elutriation tank solids level. Both digesters are sounded periodically to determine grit build-up and scum formation.

Gas produced during the digestion process is recovered from both digesters and used for mixing and as fuel for the plant steam boilers. Excess gas is burned in a single waste gas burner. Present gas production is over 200,000 cu ft per day.

Routine laboratory analysis are made on the sludge of each digester for pH, alkalinity, volatile solids, percent solids and temperature.

Solids Conditioning and Disposal

The final phase in the solids stabilization process involves the preparation of the digested sludge for its ultimate removal from the treatment plant.

Elutriation. Digested sludge and digester supernatant are conditioned prior to vacuum filtration in two elutriation tanks, east and west, located in the basement of the administration building. Each tank is 50.5 ft long by 14.7 ft wide and operates at an average water depth of 9 ft. Each tank is provided with a longitudinal sludge collector of the continuous chain and flight type and a 40-in. diameter influent mixing chamber. Two centrifugal

pumps and a plunger pump are used to transfer sludge from one tank to the other and to the vacuum filters.

Under normal operation the tanks are run on a counter-current, two-stage elutriation basis. Digested sludge and/or supernatant from the digesters flows into the east mixing chamber where it is mixed and combined with effluent from the west elutriation basin before entering the elutriation tank. Settled sludge in the east tank is moved by the chain collectors to a hopper at the tank inlet end from where it is transferred continuously to the west mixing chamber. Effluent of the east tank flows over a full width sharp crested weir and returns to the Mile Rock sewer upstream of the Sunset pumping station diversion structure. Settled sludge from the east tank is mixed and combined with No. 3 water (plant effluent) in the west mixing chamber prior to flowing into the west elutriation basin. Settled sludge in the west tank is moved by the chain collectors to a hopper at the tank inlet end from where it is pumped to the vacuum filters when these units are in operation or stored in the elutriation tanks until the next filtration period. The operation of the vacuum filters is coordinated with the operation of the digested sludge pumps to avoid overloading the elutriation system.

Filtration. Dewatering of the conditioned sludge is accomplished on two rotary drum vacuum filters situated on the first floor of the administration building. The filters are 8 ft in diameter by 8 ft long and are provided with Dacron filter media. One sludge flocculator is located next to the units. Filter auxiliary equipment is located in the administration building basement next to the elutriation tanks and includes two vacuum pumps, two filtrate pumps, one air blower and a ferric chloride chemical storage tank. Sludge can be fed to the filters either by pumping, using one of the transfer pumps, or by gravity using a bucket elevator located in the elutriation tanks area to lift the sludge to the storage bins platform level situated above the filter room. From here it flows to the sludge flocculator.

Normally, filters are operated three or four days a week for 8 to 12 hours. Ferric chloride is added in the sludge flocculator just ahead of the filters. Filter cake is collected on horizontal belt conveyors and dumped on a central sloping conveyor which carries the cake to four bins or, when available, directly to a truck. From the bins, sludge cake is loaded into trucks and hauled away. Cake is used mostly in the Golden Gate Park for filling and as soil stabilizer although some is kept available to the public on a first-come first-serve basis. Filtrate is pumped to the elutriation system or returned by gravity to the receiving well of the Sunset pumping station.

Present cake production is approximately 1,200 tons of dry solids per year at an average solids concentration of approximately 25 percent.

Supplemental Facilities

In addition to the sewage and solids treatment process structures described above, the Richmond-Sunset plant is provided with an administration building and maintenance facilities. Secondary systems include ventilation, power and control, and water.

Administration. The ground floor of the administration building includes space for the offices of the superintendent, chief engineer and chief chemist, a chemical and bacteriological laboratory, a secretary and reception area, a lunch room and a washroom. Also located on this level are the vacuum filter area, the main power panel room, a log room and a machine shop. The basement level houses the two elutriation tanks and auxiliary elutriation and filtration systems equipment, a boiler room where three steam boilers, three heat exchangers and hot water circulating pumps for digester heating are located and the Sunset pumping station motor and control room. The station pump room is located at a low sub-basement elevation.

Maintenance. Separate maintenance facilities, in addition to those housed in the administration building, are situated between the sedimentation and administration buildings and provide space for a paint and electrical shop, a machine shop and a storage room.

Ventilation. Powered exhaust air ventilation is provided in the sludge control room of the sedimentation building, digester operating building and elutriation tank area of the administration building. All air is supplied by gravity. The steam boilers provide hot water for space heating in the administration building and for digester heating. The maintenance building and the elutriation tank area of the administration building are provided with unit heaters.

Power and Control. Plant power is supplied by Pacific Gas and Electric Company. There is no source of emergency power.

Control of each phase of the treatment process is performed at separate control centers located in the pretreatment building; sedimentation tank area, sludge control room and chlorination room in the sedimentation building; digester operating building; and vacuum filter room, elutriation tank area, boiler room and Sunset pumping station motor and control room in the administration building.

All present treatment process operation, with the exception of chlorination, is manually initiated from these control centers.

Water. Water for pump gland seals, chlorine solution, filter vacuum pump and sludge gas compressor cooling, sludge concentrator sprays, and plant washdown is supplied by the No. 2 water system. This system consists of a storage tank and two booster pumps. Water for this system is supplied from the city's public domestic water system through a proper air gap. An hydropneumatic tank provided with the system is not used due to insufficient compressed air pressure. System pressure is maintained by keeping one pump running continuously. All system components are housed in a separate building located near the headworks to the plant.

The No. 3 water system provides water for scum skimming in the sedimentation tanks and wash water for the elutriation system. Three centrifugal pumps draw the system supply from the plant effluent channel after chlorine solution application. System pressure is mainteained by keeping at least one pump in operation at all times.

Water for drinking and other domestic uses is supplied by the No. 1 water system. The system consists of a storage tank, two booster pumps and a hydropneumatic tank. The system components are located in the same building as the No. 2 water facilities. Water for this system is supplied from the city's public domestic water system through a proper air gap.

Other. A portable steam cleaner is available for use throughout the treatment plant. This unit is capable of supplying both high pressure hot or cold water and steam. A separate permanent steam cleaner is presently being installed in the reconstructed pretreatment building.

Treatment Plant Personnel

The Richmond-Sunset plant has an operation and maintenance staff of 25. The plant is attended 24 hr a day. Table 2-4 lists the classes and number of personnel employed at the Richmond-Sunset plant during the 1969-70 fiscal year.

Table 2-4 Class and Number of Operating Personnel - Richmond - Sunset Plant

Class title	Number
Sewage treatment plant superintendent	1
Chief stationary engineer	1
Senior sewage treatment chemist	1
Sewage treatment chemist	2
Senior clerk typist	1
Senior stationary engineer	6
Stationary engineer	9
Truck driver	1
General laborer	3
Total	25

SOUTHEAST WATER POLLUTION CONTROL PLANT

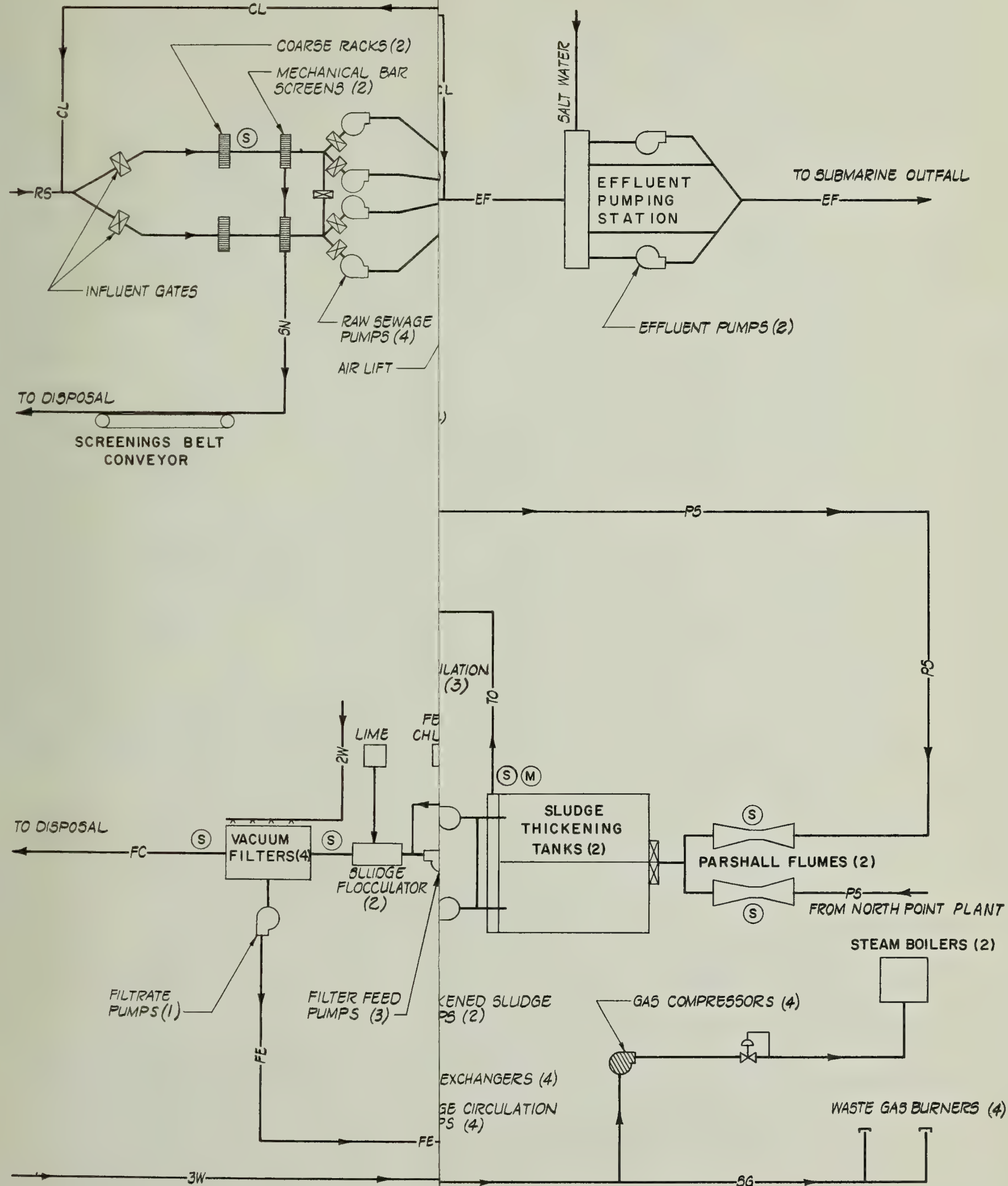
The Southeast Water Pollution Control Plant, completed in 1951 at a project cost of $7,000,000, serves a dry weather flow area of approximately 10,200 acres. The plant serves the heavy industrialized area situated in the southeast corner of the City of San Francisco. The tributary area also includes some residential developments. The plant has undergone major modifications in practically all of its treatment units, the latest of which, involving extensive reconstruction work in one sedimentation building, is proceeding at the present time.

The Southeast plant can be more accurately described as two separate treatment plants at a single site divided by a public artery, Jerrold Avenue. One is a conventional primary treatment plant serving the southeast tributary area. The other provides solids treatment both to the sludge and scum pumped from the North Point plant and to the raw sludge and scum removed at the Southeast primary plant.

Sewage Treatment

The Southeast primary treatment plant consists of prechlorination, screening, influent pumping, grit removal, preaeration and primary sedimentation, postchlorination and effluent disposal. With the exception of the grit tanks and day tank for elutriated sludge to filters, all the treatment units are housed for improved appearance and odor control. The main plant structures include a headworks building, two sedimentation buildings, a sludge control building, administration and maintenance buildings, and a chlorination building. An effluent pumping station is located at a separate site between Third Street and Arthur Avenue.

A flow diagram of the various treatment units and the functions that they perform is shown on Fig. 2-8. Design and actual process and equipment data are given in Table 2-5. Hydraulic profiles showing water surface elevations at present average dry weather flow and estimated maximum hydraulic capacity of the Southeast plant are presented on Fig. 2-9.



3. ONLY THREE DIGESTERS IN USE DURING THE WEEK OF AUGUST 26 TO SEPTEMBER 2, 1970.

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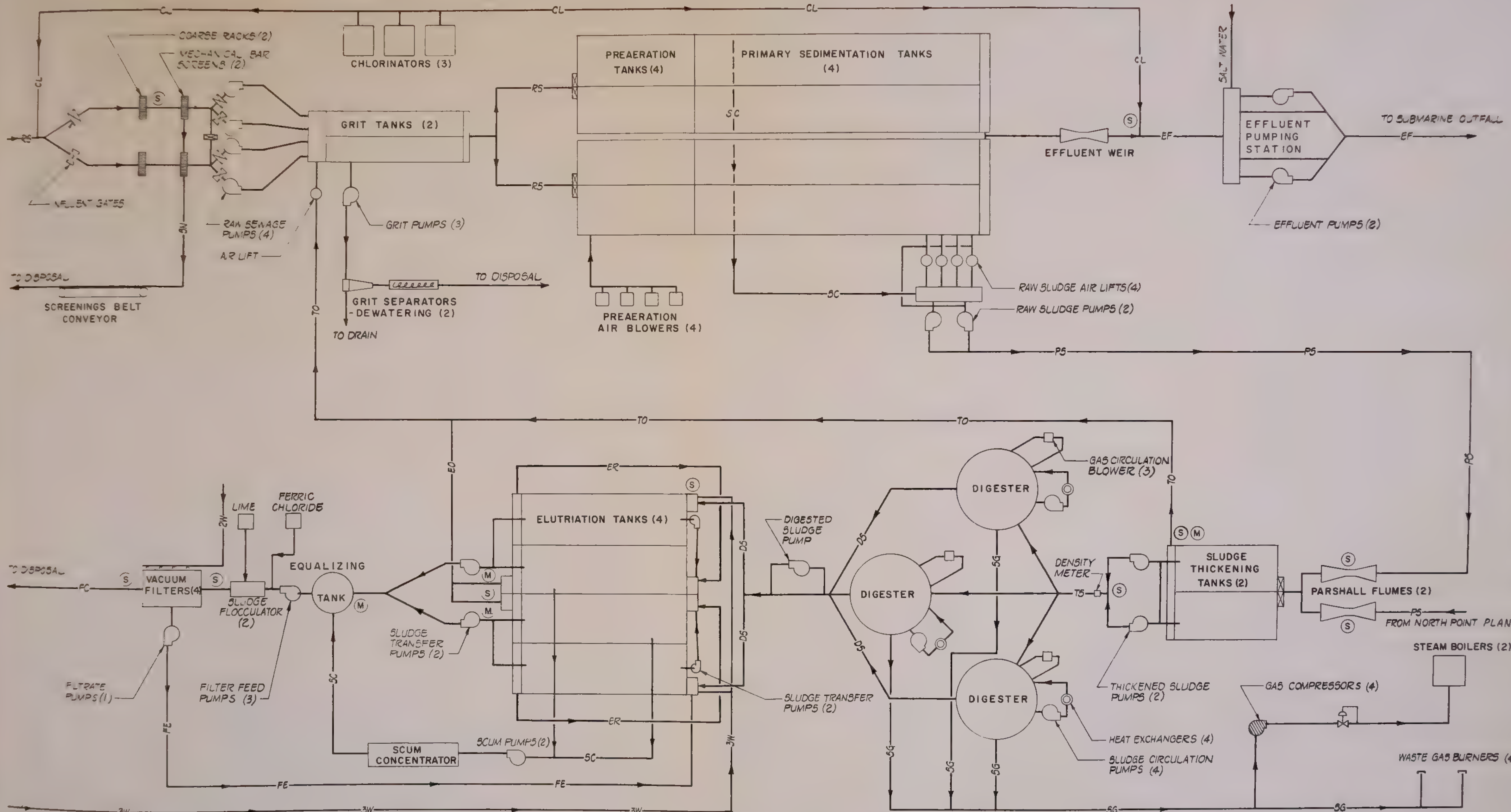
CHECKED	SUBMITTED	APPROVED

SOUTHEAST PLANT FLOW DIAGRAM

SHEET NUMBER ___ OF ___

DRAWING NUMBER Fig. 2-8



NOTES

1. THE FLOW DIAGRAM OF THE ELUTRIATION SYSTEM SHOWS THE MODE OF OPERATION DURING THE WEEK OF AUGUST 26 TO SEPTEMBER 1, 1970
2. FOR LEGEND SEE FIG 2-1
3. ONLY THREE DIGESTERS IN USE DURING THE WEEK OF AUGUST 26 TO SEPTEMBER 2, 1970.

BROWN AND CALDWELL
CONSULTING ENGINEERS
SAN FRANCISCO · ALHAMBRA, CALIFORNIA

FILE F-265E
DATE DEC 1970

CITY AND COUNTY OF SAN FRANCISCO
REPORT ON WATER POLLUTION CONTROL PLANTS

SOUTHEAST PLANT
FLOW DIAGRAM

Fig. 2-8

Table 2-5 Process and Equipment Data - Southeast Plant

	Design[a]	Present[b]
SEWAGE TREATMENT		
Basic Data		
Flow, mgd		
Minimum dry weather, (min/avg/max)	-/-/-	8.5/9.4/11[c]
Average dry weather, (min/avg/max)	-/30/-	17/20/21[c]
Peak dry weather, (min/avg/max)	-/-/-	25/28/30[c]
Peak wet weather, (min/avg/max)	-/70/-	- /31/47[d]
Maximum hydraulic capacity	-	70
Loadings, 1000 lbs/day		
Suspended solids, (min/avg/max)	-/-/-	42/69/83[c,e]
5-day, 20C, BOD, (min/avg/max)	-/-/-	18/45/60[c,e]
Screening		
Influent sluice gates		
Number	2	2
Diameter, feet	5	5
Parshall flumes		
Number	2	abondoned
Throst size, feet	1	abondoned
Coarse racks		
Number	2	2
Clear opening, inches	4	4
Mechanical bar screens		
Number	2	2
Channel width, feet	6	8.5
Bar thickness, inches	3/8	3/8
Clear opening between bars, inches	3/4	3/4
Screening removal		
Average, cu ft/mil gal	-	f
Maximum day, cu ft	-	f
Influent pumping		
Raw sewage sumps		
Number	2	2
Maximum volume, 1,000 gallons/sump	150	negligible
Raw sewage pumps		
Number	4	4
Capacity, mgd/pump		
No. 1	20	27
No. 2	10	17
No. 3	10	17
No. 4	20	27
Grit Removal		
Grit tanks		
Number	2	2
Length, feet	84	40.5
Width, feet	8	10
Average depth, feet	-	13
Grit pumps		
Number	4	3
Flow, gpm/pump	300	300
Grit separators, dewatering, cyclone type		
Number	1	2
Grit and screenings removal		
Average, cu ft/mil gal	-	6.6[d,f]
Maximum day, cu ft	-	660[d,f]
Preaeration and primary sedimentation		
Preaeration tanks		
Number	4	4
Length, feet	69	69
Width, feet	37	37

Continued on next page

Table 2-5 Process and Equipment Data - Southeast Plant (Continued)

	Design[a]	Present[b]
Preaeration and primary sedimentation (continued)		
Preaeration tanks (continued)		
Average depth, feet	12	11
Detention time, hours, all tanks operating, average dry weather flow, (30,20 mgd)	0.6	1.05
Preaeration and grit removal air blowers		
Number	4	4
Capacity, cfm/blower	1,500	1,500
Primary sedimentation tanks		
Number	4	4
Length, feet	193	178[g]
Width, feet	37	37
Average water depth, feet	12	11
Detention time, hours, all tanks operating average dry weather flow, (30,20 mgd)	1.9	2.8
Overflow rate, gal/ sq ft/day, all tanks operating average dry weather flow, (30,20 mgs)	1,050	760
Mean forward velocity, ft/min, all tanks operating average dry weather flow, (30, 20 mgd)	1.6	1.2
Chlorination		
Chlorine storage tanks		
Number	1	1
Capacity, tons	40	40
Evaporators		
Number	4	3
Capacity, lb/day total	6,000	8,000
Chlorinators		
Number	4	3
Capacity, lb/day total	1,600	8,000
Effluent Pumping		
Effluent pumps		
Number	-	2
Maximum, rpm	-	555
Maximum capacity, mgd/pump	-	46
Head @ maximum capacity flow, feet	-	32
Effluent Disposal		
Submarine outfall		
Size, inches	72	54 to 16
Total length, feet	2,450	820
Diffusers		
Number	-	18
Size, inches	-	10 x 6
Length of section, feet	-	300
SOLIDS TREATMENT		
Sludge and Scum, removal and pumping		
Raw sludge air lifts		
Number	4	4
Scum removal equipment		
Number	4	4
Type	Rotary skimming type	Rotary skimming type
Raw sludge sumps		
Number	2	2
Capacity, cu ft/sump	925	925
Raw sludge pumps		
Number	2	2
Capacity, gpm	300	300
Solids Thickening		
Raw sludge parshall flumes		
Number	2	2
Throat width, feet	0.5	0.5

Continued on next page

Table 2-5 Process and Equipment Data - Southeast Plant (Continued)

	Design	Present
Solids thickening (continued)		
Thickening tanks		
Number	2	2
Length x width, feet	91 x 12	91 x 12
Average depth, feet	12	12
Scum skimmers		
Number	2	4
Type	Tipping trough, traveling flight	2-2
Thickened sludge pumps		
Number	5	2
Capacity, gpm/pump	2 @ 300: 3 @ 320	h
Solids Digestion		
Sludge digestion tanks		
Number	10	3[i]
Internal diameter, feet	100	100
Side water depth, feet	32	32
Maximum volume, 1,000 cu ft/tank	240	240
Digesters loadings		
Assumed solids content, percent	-	5.25
Loading, 1,000 lb dry solids/day	-	152[d]
Loading, lb day solids/cu ft/day	-	0.22
Detention time, days	-	15.5
Assumed volatile solids, percent	-	69[e]
Assumed volatile solids destroyed, percent	-	32[e]
Volatile solids destroyed, 1,000 lb/day	-	47[d,e]
Solids mixing		
Sludge circulation pumps		
Number	8	4[i]
Capacity, gpm/pump	400	400
Sludge transfer pumps		
Number	10	3[i]
Capacity, gpm/pump	2 @ 200: 8 @ 120	200
Sludge Gas System		
Gas circulation blowers		
Number	-	6
Capacity, cfm, blower	-	2 @ 166: 4 @ 215
Gas compressors		
Number	4	4
Capacity, cfm /compressor	325	325
Sludge gas burners		
Number	4	4
Capacity, 1,000 cu ft/hr /burner	20	20
Sludge Heating System		
Hot water heaters		
Number	-	2
Capacity, million btu/hr /heater	-	6
Hot water circulation pumps		
Number	-	2
Capacity, gpm /pump	-	350
Sludge heat exchangers		
Number	8	4[i]
Capacity, million btu/hr /heat exchanger	1.5	3
Solids Conditioning and Disposal - Elutriation		
Digested sludge pump		
Number	-	3
Capacity, gpm/pump	-	1 @ 150: 2 @ 300
Elutriation tanks		
Number	8	4[i]
Length x width, feet	60 x 16	60 x 16
Average depth, feet	12.5	12.5 & 11.5

(continued on next page)

Table 2-5 Process and Equipment Data - Southeast Plant (Continued)

	Design	Present
Solids Conditioning & Disposal - Elutriation		
Elutriated sludge pumps		
Stage I pumps		
Number	4	2
Capacity, gpm/pump	-	h
Stage II pumps		
Number	-	2
Capacity, gpm/pump	-	300
Elutration scum pumps		
Number	-	1
Capacity, gpm/pump	-	h
Scum concentrator		
Number	-	1
Elutriated sludge equalizing tanks		
Number	-	1
Diameter, feet	-	22
Depth, feet	-	4[i]
Maximum volume, cu ft	-	1,500[i]
Solids Conditioning and Disposal - Filtration		
Filter feed pumps		
Number	-	3
Capacity, gpm/pump	-	70
Vacuum pumps		
Number	2	3
Capacity, cfm	-	h
Vacuum, inches mercury	5-7	4-11
Vacuum filters		
Number	4	4
Capacity, tons/day		
No. 1 and No. 2	50	150
No. 3 and No. 4	50	50
Diameter, feet x length, feet		
No. 1 and No. 2	8 x 14	11.5 x 16
No. 3 and No. 4	8 x 14	8 x 14
Filtrate pumps		
Number	2	4
Capacity, gpm/pump	-	h
Storage bins		
Number	1	2
Capacity, tons total	-	100
SUPPLEMENTAL FACILITIES		
Ventilation		
Administration building		
Recirculating fan	-	1
Headworks Building		
Supply fans		
Number	6	0
Exhaust fans		
Number	2	2
Chlorination building		
Emergency exhaust fan		
Number	1	1
Digestion control building		
Exhaust fans		
Number	2	2
Receiving and thickening building		
Exhaust fans		
Number	-	1

(continued on next page)

Table 2-5 Process and Equipment Data - Southeast Plant (Continued)

	Design	Present
Utilities		
No. 1 and No. 2 water system		
Tank storage		
Number	1	1
Capacity, 1,000 gallons	15	15
No. 3 water pumps		
Number	5	5
Capacity, gpm/pump - utility	2 @ 300	h
Capacity, gpm/pump - chlorination	1 @ 360	-
	1 @ 420	-
	1 @ 600	-

[a] Data represents information developed from original initial construction drawings and information supplied by paper entitled "Municipal Sewage and Waste Treatment - Treatment Plants" as prepared by the Sewage and Waste Division of the Bureau of Sewer Repair and Sewage Treatment in 1958.

[b] Unless otherwise noted, data represents actual field observations, office calculations and information obtained from city engineering and plant personnel.

[c] Based on flow measurements taken during 7-day sampling.

[d] From "Summary of Treatment Plant Operation" 1969 - 1970.

[e] Based on 7-day sampling program results.

[f] Screenings and grit are stored in the same bins.

[g] New tank length.

[h] Pumps have been plant modified since original installation, no information is available on present capacity.

[i] Number used under normal operation.

Emergency Bypass. The treatment plant capacity during wet weather is based on a rainfall intensity of 0.02 in. per hour. This provides sufficient capacity to treat all dry weather flows. Storm flows in excess of 0.02 in. per hr are bypassed directly to San Francisco Bay. Bypassing takes place by throttling the inlet gates. In case of a power failure these gates close automatically and all the incoming flow is bypassed to the bay. Other conditions that may cause emergency flow diversion are breakdowns in the bar screens, influent pumps, grit removal tanks or sedimentation tanks.

Screenings. After passing through an influent chamber where chlorine is applied, the flow is divided into two channels located approximately 23 ft below ground level. Each channel is provided with a 5-ft diameter hydraulically operated sluice gate, a 6-ft wide manually cleaned coarse bar rack and an 8.5-ft wide mechanically cleaned bar screen.

Normally, and to a great extent due to the limitations imposed by the construction projects undertaken during the last several years, only one inlet channel is kept in service. The large floating debris which is retained in the coarse rack is removed manually by lifting the rack assembly to an operation platform approximately 3.5 ft below ground level. After passing through the coarse screens, the incoming sewage flows through the original grit chamber and measuring flumes, now abandoned, and the mechanical bar screens. The mechanical bar screens are of the front-cleaned, back-return type provided with 18 cleaning rakes. The screens can be either operated on timer control or run continuously. Timer control is the normal mode of operation during dry weather, while manual control is the normal wet weather operation mode. Screenings retained on the bar racks of the mechanical bar screens are lifted 57 ft to the headworks building roof by the cleaning rakes and dumped onto a covered belt conveyor. The belt conveyor carries the screening to a storage bin from where it is hauled by truck periodically to the city dump.

Influent Pumping. Sewage leaving each mechanical bar screen flows into a small separate sump. A constant speed 11,700 gpm pump and a variable speed 18,500 gpm pump are connected to each sump through a common 33-in. suction line. The raw sewage pumps are located in a 1300 sq ft room 36.5 ft below ground level.

The two sumps are interconnected with a sluice gate to provide standby for each other. Each influent pump discharges independently to the pump discharge chamber ahead of the grit removal tanks. The discharge lines from the constant speed units

are 24 in. in diameter while the discharge lines from the variable speed units are 30 in. in diameter. Each discharge line is provided with a flap gate for backflow prevention.

Normally, the variable speed pumps run continuously with speed changing according to water surface variations in its related sump. With increasing water level, the constant speed pump starts and runs until the water surface drops to about 6 ft above the lower level in the screen channel. When both pumps are running their combined capacity is over 35 mgd. Suction channel and discharge piping velocities are maintained sufficiently high to eliminate deposition of grit and organic material.

Overflow from sludge thickening and elutriation tanks is returned to the pump discharge chamber. An airlift is used to boost the tank overflows into the discharge chamber.

Grit Removal. Grit is removed in two rectangular tanks, 40.5 ft long and 10 ft wide with a depth of about 13 ft at the present average dry weather flow of approximately 19 mgd. These units replaced the original grit chambers and were designed to operate as aerated grit chambers. The aeration system has been abandoned, however, and the tanks now operate as straight-through flow units.

Sewage from the pump discharge chamber flows through a connecting channel and enters each grit tank separately through an isolating cutoff gate. Effluent from the tanks passes over a full width transverse rectangular weir, free falling into a common collection channel.

Settled grit is moved to a collection hopper located at the inlet end of each tank by continuous chain flights which operate in a trough running along the entire bottom of the tank. Normally, both grit removal basins are in operation and collectors run continuously.

Grit Disposal. Grit disposal is accomplished by pumping from the collection hopper to a separator-dewatering unit. Three grit pumps and two separator-dewatering units are included in the system.

The three grit pumps are located directly beneath the grit tank influent channels. The pumps are motor driven, constant speed units. Suction lines are manifolded to allow the middle pump to act as a standby for the other two units.

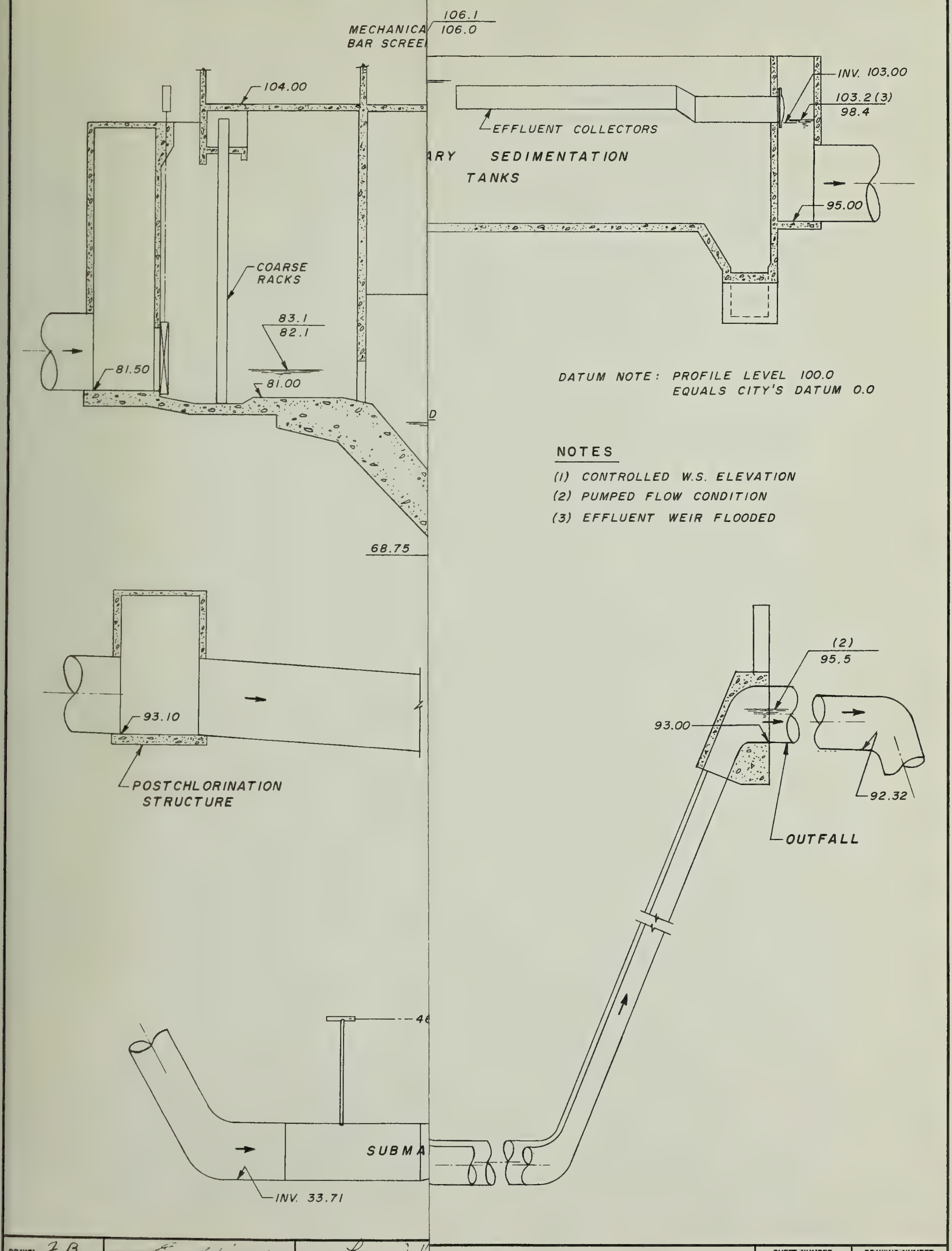
The separator-dewatering units are mounted on the roof of the headworks building. Separators are of the cyclonic type and are mounted alongside the dewatering units. Dewaterers are of the screw type and are provided with washwater to remove any organic material which might get through the separator. Overflow from the dewatering units is returned to the headworks through the plant drainage system. Washed grit is dumped directly into the same hoppers used to store screenings and is periodically hauled to the city dump.

Primary Sedimentation. Discharge from the grit tanks normally flows to four combination preaeration-sedimentation tanks. These units are arranged in pairs in two separate buildings. During the time this study was made, the tanks in building No. 1 were being modified although one tank was being kept in operation to assure adequate treatment during the construction period.

Each preaeration-sedimentation tank is 262 ft long, 37 ft wide and has an average depth of 11 ft at present ADWF. When modified, the tanks in building No. 1 will be only 247 ft long, with the last 15 ft being abandoned. Fig. 2-10 shows detention time, overflow rate and mean forward velocity plotted against flow for each new tank.

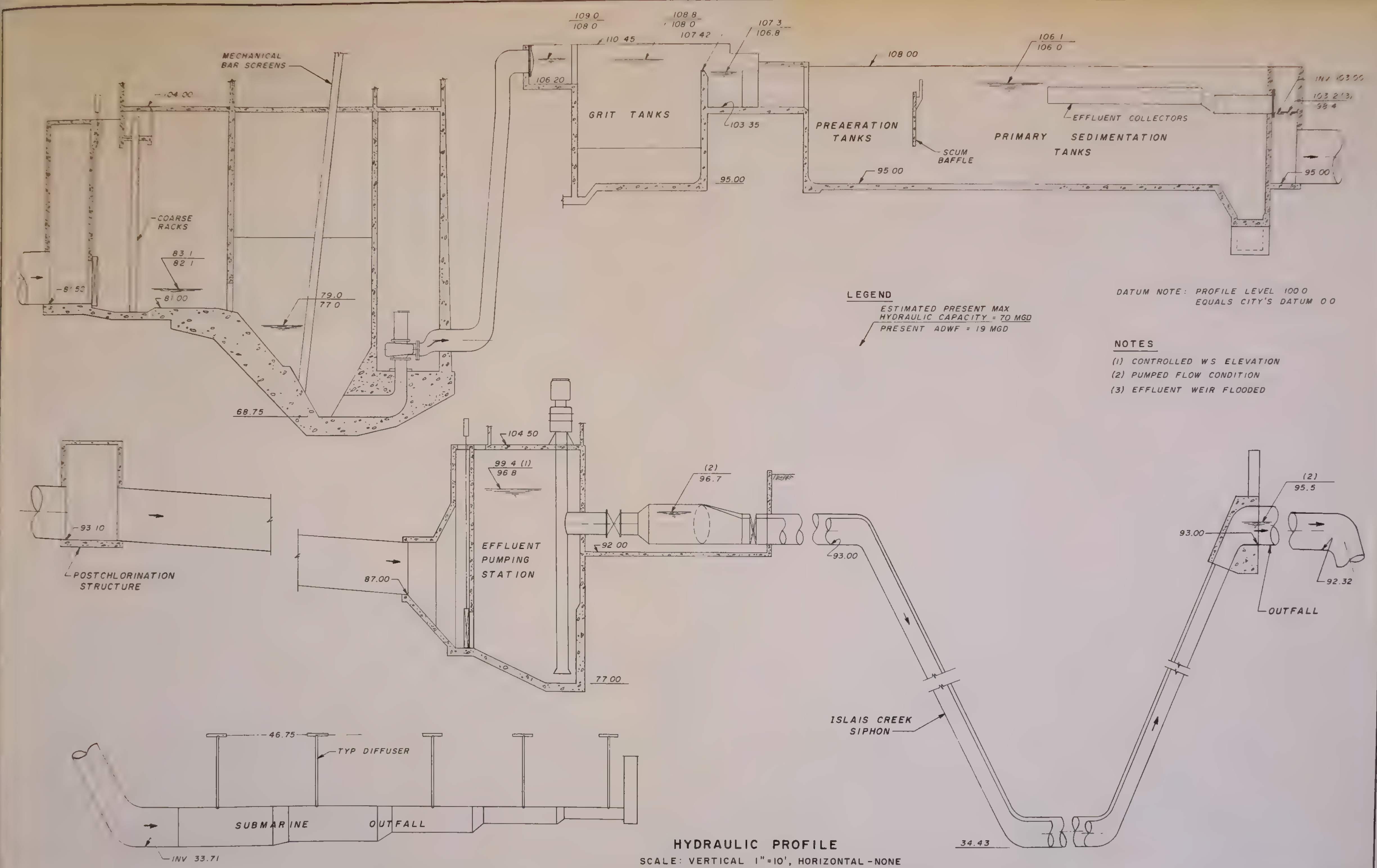
The first 79 ft of each tank is provided with four longitudinal rows of air diffusion plates for preaeration of the incoming sewage prior to sedimentation. In the modified tanks, the diffuser plates are being replaced by spargers. Compressed air for diffusers is supplied by four centrifugal blowers, each rated at 1520 cfm. Blowers are located on the ground floor of the headworks building.

Effluent is collected from each primary sedimentation tank through four metal launders provided with adjustable weirs on both sides. In the modified units effluent will be collected through a system of vertical pipes located along the launder bottoms. Each launder has a weir length of approximately 73 ft, extends approximately 92 ft toward the influent end of the tank and discharges through a 30-in. diameter submerged pipe into a common collection channel. Each discharge pipe is equipped with a backflow preventing flap gate at its point of discharge. In the modified units, effluent will be collected through a system of 56 3-in. vertical pipes spaced at 16 in. and located along the bottom of the launders. Prior to the beginning of the present modification, all preaeration-sedimentation tanks were equipped with two full length longitudinal collectors and a cross collector for sludge collection. The cross collector was located at the effluent end of each tank. Modifications to the two tanks in building No. 1 will relocate the cross collector to the approximate middle of the tanks with the result that each tank will have two sets of much shorter longitudinal collectors and the effluent end collector will be moving the sludge away from instead of towards the effluent end of the tanks. All sludge collectors are and will continue to be of the continuous chain and flight type. Existing tank collectors are driven by a singled common motor for each tank. Drives in the modified tanks will be provided with individual speed adjustable hydraulic motors for each collector. Hydraulic power units are to be located in the existing sludge control building.



DRAWN F.B.	DESIGNED	APPROVED	SOUTHEAST PLANT	SHEET NUMBER
CHECKED	SUBMITTED	APPROVED	HYDRAULIC PROFILE	___ OF ___

DRAWING NUMBER Fig. 2-9



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DRAWN F.B. CHECKED	DESIGNED SUBMITTED	APPROVED 2/5/70 Date APPROVED Date	BROWN AND CALDWELL CONSULTING ENGINEERS SAN FRANCISCO - ALHAMBRA, CALIFORNIA	FILE F-265E DATE DEC 1970	CITY AND COUNTY OF SAN FRANCISCO REPORT ON WATER POLLUTION CONTROL PLANTS	SOUTHEAST PLANT HYDRAULIC PROFILE	SHEET NUMBER ___ OF ___	DRAWING NUMBER Fig. 2-9

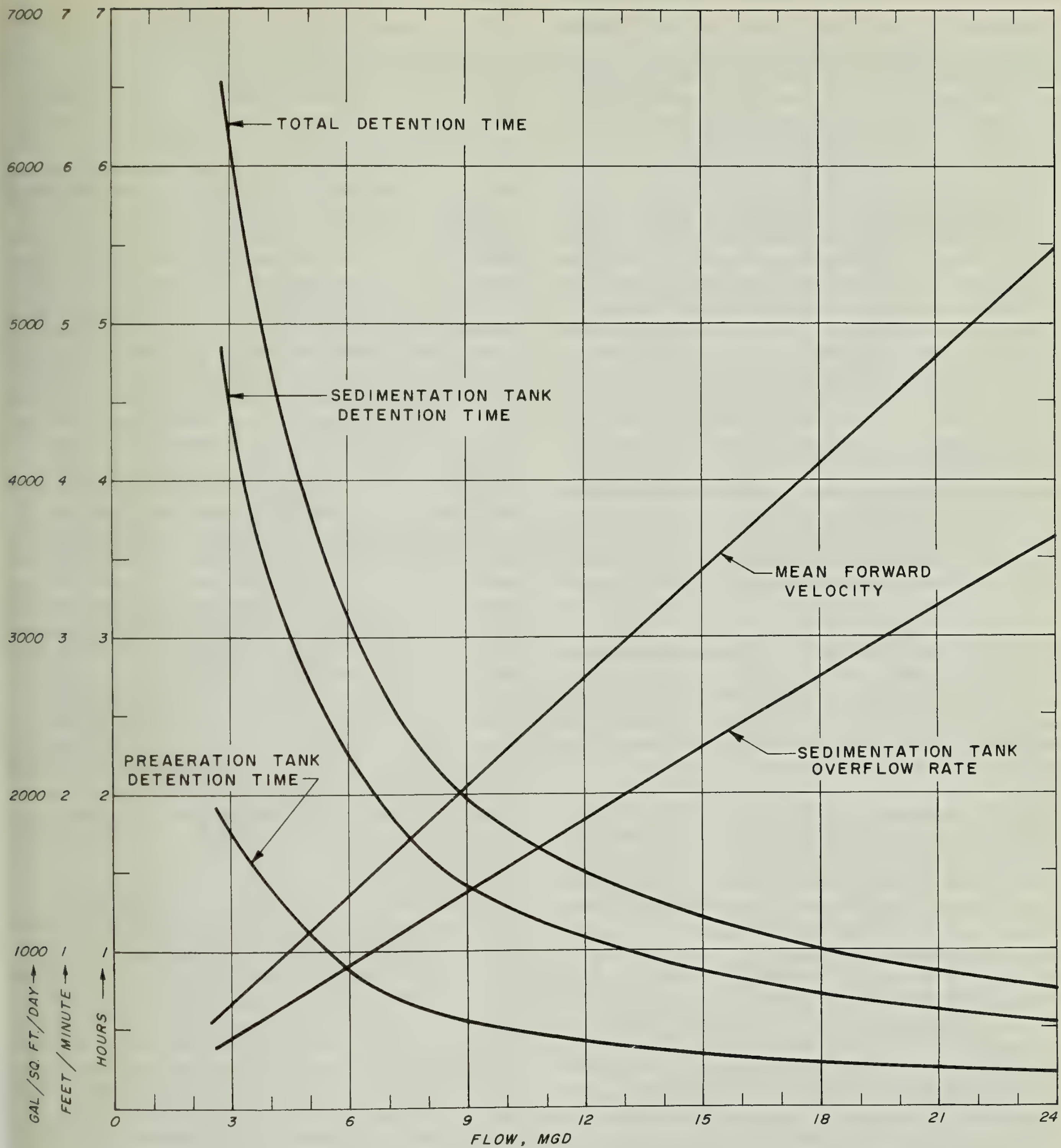

Fig. 2-10 New Preaeration-Sedimentation Tank Parameters - Southeast Plant

Scum collected on the water surface of the existing sedimentation tanks, upstream of the effluent launders, is moved by water sprays to a tipping trough located just downstream from the preaeration segment of each tank. Scum rising to the surface in the vicinity of the effluent launders is isolated from the weirs by redwood outboard baffles and collected near the tank end wall by manually adjustable skimming troughs. Two skimming troughs are provided for each tank. Modifications presently underway to the tanks in building No. 1 will eliminate all existing skimming facilities and replace them with two full width scum skimmers located at both ends of the effluent launders.

The unit at the upstream end of the launders will be an electrically driven, double rubber blade rotating skimmer. The one at the downstream end will be of the manually operated tipping trough type.

Under normal conditions, three tanks are in operation. Tanks are taken out of service at regular intervals for maintenance and repair.

Chlorination. Chlorination facilities provide for prechlorination of influent sewage for odor control and hydrogen sulfide suppression and for postchlorination of plant effluent for disinfection.

These facilities include three hot water type evaporators and three V-notch chlorinators each with a capacity of 8,000 lb per day. Evaporators and chlorinators are piped to operate as integral units. One chlorinator is used for prechlorination and the other two for postchlorination. All facilities are housed in a separate chlorination building. Chlorine storage is provided by a 40 ton capacity tank located adjacent to the chlorination building. Liquid chlorine is delivered by railroad tank car to a spur track within the plant site.

Chlorine solution for prechlorination is applied to the raw sewage in an influent structure immediately preceeding the headworks building. The rate of chlorine application is high, being between 250 and 300 lb per million gallons. Dosage is controlled by a signal from the effluent meter.

Chlorine solution for postchlorination is applied through diffusers in the effluent channel just outside the sedimentation buildings. Dosage is set between 250 and 350 lb per million gallons.

Effluent Pumping. After passing over a lateral measuring weir located in the building No. 2 collection channel, plant effluent is chlorinated and flows into a 6-ft diameter reinforced concrete sewer. The effluent sewer is approximately 2,900 ft long and terminates in the outfall booster pumping station built in 1968. Effluent flows into two 29.5 by 10-ft sumps, each provided with a 48 by 48-in. hydraulically operated inlet sluice gate. The sumps are separated by an overflow chamber that allows effluent to flow directly by means of a 6-ft pipeline into Islais Creek when the pumps are inoperative and the effluent cannot get out through the outfall by gravity. Two effluent pumps are housed in a 1,050 sq ft room located directly above the receiving sumps, one pump for each sump. This room also houses the station control panel and the master hydraulic power unit. Pumping units are motor-driven, variable speed mixed flow pumps. Each pump is capable of delivering approximately 32,000 gpm when operating at a maximum speed of 555 rpm against a head of approximately 32 feet. Each pump discharges into a 42-in. steel pipe which connects to a 54-in. manifold. Two 30-in. gravity lines also interconnect the sumps to the 54-in. manifold. the manifold in turn divides into separate 42-in. and 36-in. lines which cross Islais Creek as a two-barrel inverted siphon. Pump discharge and gravity interconnecting lines are provided with hydraulically operated control valves. One pump is operated as a standby for the other pump.

When plant effluent can no longer discharge by gravity through the outfall to San Francisco Bay, the level in the pumping station sumps rises until a preset elevation is reached at which time one pump starts at low speed, the pump's discharge line control valve opens and the 30-in. gravity interconnecting line control valves close. Pump speed changes with flow variation to maintain a constant sump level. When the level drops below the minimum set elevation, the pump discharge line control valve closes, the pump stops, the 30-in. gravity interconnecting line control valves open and the plant effluent again flows by gravity through the outfall to the bay.

At the time this report was written, the effluent pumping station was being modified to allow continuous pumping of a mixture of salt water and plant effluent. This modification includes the installation of antirotation baffles within each sump to make it possible for the pumps to operate at the lower sump levels necessary to bring in salt water from Islais Creek. When operating in this mode, the sump operating level is lowered below the salt water level in the overflow chamber and a 72 by 48-in. hydraulically controlled sluice gate between the overflow chamber and the intake distribution chamber is opened, thus permitting salt water to flow into the sumps. Controls are designed to close this gate whenever the level in the pump sumps approaches the level of the salt water in the overflow chamber.

Effluent Disposal. From the outfall booster pumping station, the effluent flows through the Islais Creek inverted siphon and into a special manhole where the plant outfall begins. The outfall consists of approximately 4,250 ft of 54-in. diameter pipe, 500 ft of which is laid in the transition and offshore sections, and a 300-ft submarine diffuser section. The diffuser section reduces in size from 54 in. to 16 in. and is provided with 18 T-shaped diffusers, each with two lateral ports. The vertical section of each diffuser is about 8.5 ft long and 10 in. in diameter. The laterals are each 4 ft long and 6 in. in diameter.

Solids Treatment

As stated previously, the Southeast plant is provided with facilities to treat not only the sewage solids removed during the primary treatment process at the plant site but also the sludge that originates at the North Point plant. The processes in-

clude gravity thickening, sludge digestion, elutriation, digested sludge chemical conditioning and sludge dewatering.

Sludge and Scum Removal. Sludge from the cross collector hoppers of the existing preaeration-sedimentation tanks flows by gravity in 10-in. lines to an airlift in the sludge control building. Each tank has its own airlift for pumping sludge. All airlifts discharge into a common sludge and scum sump. Two centrifugal pumps, located in the pump room adjacent to the sump, are used to pump the sump material to the sludge thickening tanks in the solids treatment area across Jerrold Avenue. Piping is arranged to permit pumping directly from the gravity lines to the thickening tanks. Scum collected by the tipping troughs flows by gravity to the common sludge and scum sump.

Under normal operation the airlifts run continuously and the sludge pumps are started and stopped automatically by the level variations in the sump. When sludge production is high in the primaries, one of the pumps is used to pump directly from each tank in sequence and the other to pump from the sump.

Modifications presently being made to the two tanks in sedimentation building No. 1 will completely revise sludge and scum removal facilities for these tanks. The modifications include construction of two sludge pumping stations and a new scum collection system at each of the tanks. Each pumping station will contain two sludge removal pumps with short suction pipes connecting to each tank's sludge hopper. The sludge removal pumps will discharge into the new scum collection system troughs and the sludge and scum combination will flow by gravity to two transfer sumps in the new sludge pumping station located between the two sedimentation buildings. Each transfer sump will be equipped with a multi-bladed turbo-mixer. Two sludge transfer pumps will be provided at each sump and will pump the sludge and scum to the sludge thickeners through a new 6-in. force main.

Sludge Thickening. Sludge from the North Point plant is discharged directly to the sludge thickening facilities along with that from the Southeast plant. The two separate flows are measured independently through 6-in. Parshall flumes prior to being mixed and discharged to the thickening tanks.

Sludge thickening facilities consist of two gravity separation type thickening tanks and a thickened sludge pumping station. Each sludge thickener is 91 ft long by 18 ft wide and has an average water depth of approximately 12 feet. Tanks are provided with longitudinal sludge collectors of the continuous chain and flight type. Collectors run the entire length of each tank. The longitudinal collectors move the thickened sludge to two separate scum skimmers. One is a transverse continuous chain and flight type skimmer located at the inlet end of the tank while the other is the manually operated tipping trough type located near the effluent end of the tank. The transverse inlet skimmer operates intermittently and discharges directly into a large scum collection sump. Scum at the outlet end of the tank is removed manually once a day and flows by gravity to the same sump.

Thickening tank overflow is collected in a full width transverse trough near the outlet end of the thickeners. The overflow flows through a 22-in. return line to the raw sewage pump discharge chamber. A low head air lift pump mounted on the 22-in. line pumps the overflow to the discharge chamber. At the time this study was made, only the east thickening tank was in service.

A sludge transfer pumping station is located at the inlet end of the thickeners. The station contains a pump room and a control room. The control room houses the process control and instrument panel and has direct access to the thickening tanks walkways. Two centrifugal pumps are provided in the pump room to pump thickened sludge to the digesters. The pumps are interconnected to be able to pump from either tank.

Pump operation is automatically controlled by timer and density meter. Pump starting is initiated by timer and pumping continues for as long as solids concentration remains above the minimum concentration set on the density meter. As soon as the concentration drops below this point, the pump shuts off and the timer is reset for the next operation. Normally, only one pump is used to transfer sludge to the digesters.

Scum from the collection sump is pumped manually at least once a day to the digesters using the sludge pumps. If either sludge or scum density is such that it is difficult to pump, the two pumps are connected in series. This operation is also manually performed. Total solids content of the thickened sludge and scum averages approximately 5.5 percent.

Sludge Digestion. The Southeast treatment plant is provided with ten digesters divided in two groups of five tanks, each arranged around a central control building. Each tank is 100 ft in diameter with a side water depth of 20.5 ft and is provided with a floating cover. Digesters were originally designed as standard rate tanks, but three of them, tanks Nos 7, 8, and 9, have been converted to high rate operation by the installation of internal gas mixing systems. Each control building houses sludge circulation and transfer pumps, heat exchangers and control panels.

Present operation involves the normal use of only the three high-rate digesters with the

two standard-rate digesters in the group available for standby service. Sludge can also be fed to the other group of five tanks but this is done only on an emergency basis. At the present time all of these five tanks are almost completely filled with inactive sludge.

Thickened sludge is pumped to digesters Nos 7, 8, and 9 every day in sequence, approximately eight hours to each tank. Before feeding thickened sludge to any digester, digested sludge is withdrawn from that unit until its floating cover drops about five feet below the tank overflow point. The digester level is then allowed to rise during the eight hours pumping cycle. The feeding point for thickened sludge is at the wall side in digester No. 7 and at the center in digesters Nos 8 and 9. thickened sludge is not heated or mixed prior to entering the digester.

Digested sludge is usually withdrawn by graity to the elutriation tanks. On occasions, it is pumped to increase its flow and to flush the lines. A vertical centrifugal pump is used for this purpose in digester No. 7 while new horizontal centrifugal pumps have been installed in the basement of the sludge control building for pumping from digesters Nos 8 and 9. Positive displacement pumps are available but are not normally used.

Solids Mixing. Mixing of the digester contents is accomplished by injecting compressed sludge gas through diffusers located at the tank bottom. Gas is compressed by three rotary type gas compressors, to 15 psi for injection into the digesters. Digester contents are also mixed by the sludge recirculation pumps operating in conjunction with the heat exchangers and the discharge piping ring around each high-rate digester.

Gas System. Sludge gas produced in the digestion process is metered and then goes to the gas compressor building where it is compressed to a pressure of 28 ounces per square inch. Gas is used for digester contents mixing and as fuel for two steam boilers. Excess gas is burned in four waste gas burners. A gas holder provided in the original installation is no longer used.

Heating System. The temperature of the digestion tanks contents is maintained at approximately 95°F. Digesting sludge is circulated continuously through spiral heat exchangers using vertical centrifugal pumps. Hot water provided by steam-to-water heat exchangers is used to heat the spiral heat exchangers. Heated sludge may be returned to only one point in digester No. 7 and to any of 20 different points in digesters Nos 8 and 9. Return points in digesters Nos 8 and 9 are changed in sequence once every shift.

Solids Conditioning and Disposal

The final phase in the solids stabilization process involves the preparation of the digested sludge for its ultimate removal from the treatment plant.

Elutriation. Digested sludge is conditioned prior to vacuum filtration in elutriation tanks. The tanks are divided into two batteries of four each and are housed in the filtration building. Each tank is 60 ft long by 16 ft wide with an average water depth of approximately 12.5 feet. Each tank is preceded by a 4 by 4-ft mixing box. Boxes are arranged in pairs and each is equipped with a mechanical mixer. Each tank is provided with a longitudinal sludge collector of the continuous chain and flight type. Four tanks, the two intermediate ones in each battery, are also provided with scum skimmers of the rotating blade type. Sludge transfer and scum pumps are located in an equipment gallery located underneath the filter room next to the inlet end of each tank.

Under normal operation, the elutriation system is operated on a counter-current, two-stage elutriation mode. When this study was made only the first group of tanks were being used (tanks Nos 1, 2, 3, and 4). Digested sludge was being fed to tanks Nos 1 and 4 and final overflow and elutriated sludge removed from tanks Nos 2 and 3, respectively. No. 3 water (screened plant effluent) was being used as stage-one elutriation wash water, while the overflow from tanks Nos 1 and 4 was being used for stage two washing. Prior to entering the elutriation tank, digested sludge was being mixed with elutriation wash water in a box provided with a mechanical mixer. This box was also receiving the filtrate and wash water discharge from the vacuum filters.

Sludge from the first-stage tanks (1 and 4) was being pumped continuously to the second-stage tanks (2 and 3). Elutriated sludge from tanks 2 and 3 was being pumped intermittently to a 22-ft diameter equalizing tank before being fed to the filters. Scum collected and removed from tanks 2 and 3 was being pumped to the scum concentrator and then discharged to the equalizing tank. Heavy scum accumulations that cannot be handled by the scum removal system were periodically being washed into the overflow troughs. Elutriation overflow was being collected in finger overflow troughs in the second-stage tanks and returned to the raw sewage pump discharge chamber via the same 22-in. line and low head air lift pump that returns the sludge thickening tank overflow.

Digested sludge normally flows continuously to the elutriation tanks. Although it is possible to bypass the elutriation tanks and pump sludge directly to the filters, this mode of operation is not practiced due to difficulties experienced in filtering unelutriated sludge.

Filtration. Dewatering of the conditioned sludge is accomplished by four vacuum filters located in a large room adjacent to the elutriation tanks. Two filters are the original 8-ft diameter by 14-ft long rotary type units rated at 50 tons of solids per day. The other two are larger and newer filters being 11.5 ft in diameter and 16 ft long. The latter are coil-type units capable of dewatering 150 tons of solids per day. Each larger filler is provided with a small sludge flocculating tank adjacent to it where coagulants are added prior to filtration. No. 2 water is used to backwash the filters after each filtration cycle. Filter auxiliary equipment includes three vacuum pumps, four filtrate pumps, two air blowers and ferric chloride and lime storage tanks. The vacuum filter operation is continuous except for a washdown and start-up period of two to three hours every morning. Normally, only one of the larger filters is used since the belt conveyor system can only handle filter cake from one big unit. The smaller units are only used in case of breakdwon of the new filters.

Digested sludge is fed to the filter from the equalizing tank by diaphragm pumps. Filter cake is carried in belt conveyors and stored in two bins from which it is trucked away to a land fill. All trucking is done at off-peak hours. Bins have the capacity of storing 100 tons. Present cake production is approximately 21,000 tons per year at an average solids concentration of 28 percent.

Supplemental Facilities

In addition to the sewage and solids treatment process structures described, the Southeast plant is provided with separate administration and maintenance buildings Secondary systems include ventilation, power and control, water, and steam cleaning.

Administration. The ground floor of the administration building includes space for the offices for the Sewage Treatment Division general superintendent, Southeast plant superintendent, chief engineer and chief chemist, drafting and log rooms, a secretary and reception area, a lunch room, washrooms, locker room, first-aid room and space for heating and ventilating equipment. The second floor provides space for chemical and bacteriological laboratories, a conference room and additional offices which at the present time are occupied by county personnel unrelated to the treatment plant functions.

Maintenance. A separate maintenance building provides space for a machine shop, where in addition to maintenance operations some spare parts for miscellaneous pieces of mechanical equipment are finished or re-machined, a parts storage room and a garage for plant vehicles. Additional space for plant equipment overhaul and tool storage is provided in a separate building.

Ventilation. Exhaust air mechanical ventilation is provided for the influent pump sumps of the headworks building, sludge control building, thickening building and vacuum filters room of the filtration building. With the exception of the thickening structure which is provided with a supply fan, all air is supplied by gravity. Central heating by steam coils is provided in the administration and maintenance buildings.

Power and Control. Plant power is supplied by Pacific Gas and Electric Company. There is no source of emergency power, consequently the treatment plant has to be shut down in the event of a power failure.

Control of each phase of the treatment process is performed at separate control centers located throughout the plant. There are control panels in the headworks building, sedimentation buildings, chlorination building, sludge control building, thickening building, digester control buildings, and filtration building. All treatment process operation is initiated from these control stations.

Water. Water for plant washdown, pump gland seal, vacuum filter washing and chlorine injection is supplied by the No. 2 water system. Water for this system is obtained from the city supply and is stored in an elevated steel tank with a 15,000 gal capacity. The tank is 100 ft high and as a result the No. 2 water system operates under relatively low pressure. Water pressure for chlorine injection is boosted by three pumps located in the chlorination building.

The No. 3 water system provides water for scum skimming in the sedimentation tanks and for elutriation wash water. To supply water to the system, plant effluent is diverted through a 72-in. diameter rotating drum strainer located alongside the sedimentation tank's effluent collection channel upstream of the postchlorination diffusers and measuring weir. From the strainer, effluent flows to a storage tank from which it is pumped by two centrifugal pumps located in the sludge control building.

Water for drinking and other domestic uses is provided by the No. 1 water system. The system is supplied by the same elevated tank that stores No. 2 water. An air gap prevents the possibility of a cross connection between the two systems and the city supply.

Steam Cleaning. The Southeast plant is not provided with a manufactured steam cleaning system.

Table 2-6 Class and Number of Operating Personnel - Southeast Plant

Class title	Number
Sewage treatment plant superintendent	1
Chief stationary engineer	1
Senior sewage treatment chemist	1
Sewage treatment chemist	3
Senior clerk typist	1
Senior stationary engineer	6
Junior stationary engineer	1
Stationary engineer	26
Truck driver	1
Janitor	1
General laborer	4
Total	45

Instead, 140 psi steam obtained from on-site boilers is piped throughout the plant.

Other. The plant is provided with two 200 horsepower steam boilers located in the abandoned sludge cake dryer building. The boilers are run on sludge gas with natural gas as stand-by. One boiler is in operation at all times, but two units are required during the winter time. Steam is used for digester heating, for plant space heating and for steam cleaning. Steam is also supplied to the city's asphalt plant located adjacent to the Southeast plant.

Treatment Plant Personnel

The Southeast plant has an operation and maintenance staff of 45. The plant is attended 24 hr a day. Table 2-6 lists the classes and number of personnel employed at the Southeast plant during the 1969-1970 fiscal year.

CHAPTER 3

TREATMENT PLANT PERFORMANCE

To evaluate the present performance of the City of San Francisco water pollution control plants, an extensive and comprehensive program of sampling and laboratory analysis was carried out during the period of July 30 to September 1, 1970. During this time samples were taken, generally at one-hour intervals, and measurements made where needed in each of the treatment plants and in the Southeast plants receiving water for seven consecutive days. Many samples were composited in proportion to flow and stored in a trailer supplied by the city and specially equipped by Brown and Caldwell for in-plant chemical determinations and chilled sample storage. Over 1,000 samples were collected during this sampling program.

Sampling points were determined from the plant's flow diagram, visual observations and discussions with the plant superintendents and senior chemists. The Bureau Superintendent and Sewage Treatment Division General Superintendent of the city's Bureau of Water Pollution Control of the Department of Public Works were also present during most of these discussions. Every attempt was made to select sampling points which were representative of the true composition of the process being sampled and were not affected by any return flows or bypassing circulation. The only significant deviation from this criteria was the influent sampling point at the Richmond-Sunset plant where the agreed-upon location resulted in the inadvertent inclusion of the raw sludge concentration tank decant flow. Whenever possible, each treatment plant process flow sampling point selected coincided with the sampling points used by the plant personnel for routine sampling. The only major difference between the study sampling and the plant routine sampling was in the method of taking samples. Sampling points, frequency, type and number are all listed in the Outline of Sampling and Analysis Program, Figs. 3-1, 3-2, and 3-3.

All study samples were collected by three specially trained young men whose main task was to get good representative grab samples at the time intervals selected. It is anticipated, therefore, that the results are as representative and uniform as can be expected in sampling at hourly intervals.

All laboratory tests were conducted in state-certified laboratories with ample experience in the field of water pollution control. Over 2,000 analyses were made as part of these laboratory tests.

The laboratory tests and analyses performed on the collected samples were selected to provide a complete and comprehensive picture of plant loadings. Where possible, on-site tests were performed on all grab samples to determine diurnal variations. Tables 3-1, 3-2, and 3-3 summarize the tests performed while Figs. 3-1, 3-2, and 3-3 show which samples received the various tests. Preliminary drafts of these figures and tables were reviewed and discussed with both the staff of the Division of Sanitary Engineering and the staff of the Maintenance and Operation Bureau of the Department of Public Works prior to the start of each sampling program.

Table 3-1 Outline of Sampling and Analysis Program - North Point Plant

July 30, 1970 to August 5, 1970

Sewage solids - Brown and Caldwell Laboratories
- Turbidity
- Grease (Standard Method)
- Settleable matter (by volume and weight)
- Solids, total and volatile
- Suspended solids, total and volatile
- Floatables

BOD - Brown and Caldwell Laboratories

Bacteriological - City's North Point WPCP Laboratory

Metals - Brown and Caldwell Laboratories
Metallurgical Laboratories
- Emission spectrograph - semi-quantitative all metals
- Atomic absorption spectrophotometer - individual metals as required

Pesticides - Allied Life Sciences Laboratory
- Chlorinated hydrocarbons

Bio-assays - Pacific Laboratories
- 96-hour TLM's

Phenols - Pacific Laboratories

Sulfides - Pacific Laboratories
- Total

Mineral analysis - Brown and Caldwell Laboratories

Grit Sieve Analysis - Abbot A. Hanks Testing Laboratory

Nutrients and COD - Brown and Caldwell Laboratories
- NH_3, NO_3^-, and NO_2^-, unassociated N
- Organic N, Total N
- Total P, as PO_4
- Total dissolved PO_4 (Ortho PO_4 + Poly PO_4)
- Chemical oxygen demand (COD)

Chlorine demand - Brown and Caldwell Laboratories

Once the results of the laboratory tests and analyses became available they were tabulated and coordinated with the flow data to produce plant loadings in terms of pounds per day. In some cases adjustments were made to raw field data to assure

Table 3-2 Outline of Sampling and Analysis Program - Richmond - Sunset Plant

August 12, 1970 to August 18, 1970

Sewage solids - Brown and Caldwell Laboratories
- Turbidity
- Grease (Standard Method)
- Settleable matter (by volume and weight)
- Solids, total and volatile
- Suspended solids, total and volatile
- Floatables

BOD - Brown and Caldwell Laboratories

Bacteriological - City's Richmond-Sunset Laboratory

Metals - Brown and Caldwell Laboratories
Metallurgical Laboratories
- Emission spectrograph - semi-quantitative all metals
- Atomic absorption spectrophotometer - individual metals as required

Pesticides - Allied Life Sciences Laboratory
- Chlorinated hydrocarbons

Bio-assays - Pacific Laboratories
- 96-hour TLM's

Phenols - Pacific Laboratories

Sulfides - Pacific Laboratories
- Total

Mineral analysis - Brown and Caldwell Laboratories
- Total mineral content of weekly composite

Nutrients and COD - Brown and Caldwell Laboratories
- NH_3, NO_3^-, and NO_2^-, unassociated NH_4OH
- Organic N, Total N
- Total P, as PO_4
- Total Soluble PO_4 (Ortho PO_4 + Poly PO_4)
- Chemical oxygen demand (COD)

Alkalinity, Brown and Caldwell Laboratories

Total iron, Brown and Caldwell Laboratories

Chlorides, Brown and Caldwell Laboratories

Table 3-3 Outline of Sampling and Analysis Program - Southeast Plant

August 26, 1970 to September 1, 1970

Sewage solids - Brown and Caldwell Laboratories
- Turbidity
- Grease (Standard Method)
- Settleable matter (by volume and weight)
- Solids, total and volatile
- Suspended solids, total and volatile
- Floatables

BOD - Brown and Caldwell Laboratories

Plant bacteriological - City's South East WPCP Laboratory

Metals - Brown and Caldwell Laboratories
Metallurgical Laboratories
- Emission spectrograph - semi-quantitative all metals
- Atomic absorption spectrophotometer - individual metals as required

Pesticides - Allied Life Sciences Laboratory
- Chlorinated hydrocarbons

Bio-assays - Pacific Laboratories
- 96-hour TLM's

Phenols - Pacific Laboratories

Sulfides - Pacific Laboratories
- Total

Mineral analysis - Brown and Caldwell Laboratories
- Total mineral content of weekly composite

Nutrients and COD - Brown and Caldwell Laboratories
- NH_3, NO_3^-, and NO_2^-, unassociated NH_4OH
- Organic N, Total N
- Total P, as PO_4
- Total Soluble PO_4 (Ortho PO_4 + Poly PO_4)
- Chemical oxygen demand (COD)

Alkalinity, Brown and Caldwell Laboratories

Total iron, Brown and Caldwell Laboratories

Chlorides, Brown and Caldwell Laboratories

Receiving Water Bacteriological - Brown and Caldwell Laboratories

Moisture Content - Brown and Caldwell Laboratories

proper comparisons and meaningful distribution results. For example, because of salt water infiltration into the low-lying interceptor sewers, particularly those tributary to the North Point and Southeast plants, determinations for total solids at those plants were abnormally high. This situation particularly affects the determinations of sludge solids which are normally considered to be almost entirely, and hence equivalent to, suspended solids. For these reasons, chloride determinations were made for both sewage and sludge samples and sludge determinations were corrected to omit the sodium chloride fraction.

Exploratory analyses for trace metals were made by emission spectrography on weekly composites of the daily composite samples. These determinations are only semiquantitative and were made to find if any metals or other trace elements were present in amounts which would affect either biological treatment processes or aquatic life. Individual daily composite samples were preserved and held for precise quantitive analysis when indicated.

Because of the heterogenous nature of sewage, many of the determinations used in describing its characteristics can only be defined as the material removed by a specific analytical procedure. Suspended solids fall in this class and in this study were determined by the "Standard Methods" Gooch crucible and asbestos mat procedure. This procedure consistently yields higher values than the glass fiber mat procedure used in the treatment plant laboratories. Results of this test are also affected by sample size. Larger samples were tested during North Point determinations but were re-

Process sampled	Sampling point	Frequency a[nd] week of s	Type of sample	Number and size of samples	Tests to be performed on sample
Plant influent	Plant channel immediately downstream from parshall flumes at discharge of grit' channels	One each	24-hour grab composite weighted by flow (sample quantity shown allows for variance to two-thirds without limiting tests)	(composite total)	Settleable solids, pH, DO, Temp
		Thursday Friday Saturday Sunday Monday Tuesday Wednesd (Day to b with 1:0 sample)		7 5-gallon	[1]Sewage solids
				7 2-quart	BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 2-quart (pres. in $HgCl_2$)	[5]Nutrients & COD
				7 1-gallon	Algae growth potential
		One at pea	Grab	(Total each sample)	pH, DO, Temp
		Thursday Friday Saturday Sunday Monday Tuesday Wednesd		7 3-gallon	Floatables, grease, settleables, Turbidity, S.S.
				7 1-pint (pres. in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-quart (pres. in $HgCl_2$)	Nutrients & COD
				2 2-gallon	[4]Pesticide
				7 100-ml (sterile bottle)	Bacteriological
		One per we	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	Metals- Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[5]Nutrients & COD

NOTES

[1]Portion of complete sewage sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A. A. spectrophotometer test as required.

[3]Retain all samples for use in detailed A. A. spectrophotometer tests as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

Process sampled	Sampling point	Frequency a[nd] week of	Type of sample	Number and size of samples	Tests to be performed on sample
Raw sludge to Southeast Water Pollution Control Plant	Raw sludge force main to Southeast plant (from sample pipe off side of force main. Pipe to run continuously in sump)	One each	24-hour grab composite weighted by flow	(composite total)	[1]pH, Temp.
		Thursday Friday Saturday Monday Wednesd		7 1-quart (pres. in ZnAc)	Sulfides, total
		Sunday Tuesday	[1]24-hour grab composite	7 1-quart	[2]Solids, total and volatile.
			7-day composite	———	Sieve analysis
		One every 4 h ginning at 4:3	24-hour grab composite	7 1-quart	[2]Solids, total and volatile
			7-day composite	———	Sieve analysis
		Sunday Tuesday	its (washers) in operation amount composited shall be double.		

Frequency	Day and type of sample	Tests to be performed
One at 8:00		
Sunday Tuesday	Wednesday 1 grab sample at each point (following peak flow through plant)	Sulfides
One each hour		
One per we		

NOTES

[1]COD run daily for a portion of sample. Remaining portion held for making up 7-day composite samples.

[2]Retain all samples for use in detailed A. A. spectrophotometer tests as required.

[3]Test run for determining Cl_2 demand only (as it relates to freshness of sewage at discharge point. Further, more detail examinations to be made as required.

[4]Samples to be perserved for possibe use of city in relation to URS study at SE plant.

DRAWN F.B.	DESIGNED Warren R ...	APPROVED	NORTH POINT PLANT	SHEET NUMBER	DRAWING NUMBER
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OUTLINE OF SAMPLING AND ANALYSIS PROGRAM

NORTH POINT WATER POLLUTION CONTROL PLANT

JULY 30, 1970 TO AUGUST 5, 1970

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Plant influent	Plant channel immediately downstream from parshall flumes at discharge of grit' channels	One each hour	24 hour grab composite weighted by flow (sample quantity shown allows for variance to two-thirds without limiting tests)	(composite total)	pH, DO, Temp
		Thursday Friday Saturday Sunday Monday Tuesday Wednesday (Day to begin with 1:00 a. m. sample)		7 5-gallon	[1]Sewage solids (turbidity on lab. settled)
				7 2-quart	BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in NaOH)	Phenols
				7 2-quarts (pres in $HgCl_2$)	[5]Nutrients & COD
		One at peak flow	Grab	(total each sample)	pH, DO, Temp
		Thursday Friday Saturday Sunday Monday Tuesday Wednesday		7 3-gallons	Floatable, grease, settleables, Turbidity (on lab, settled), S S
				7 1-pint (pres. in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-quart (pres in $HgCl_2$)	Nutrients & COD
				2 2-gallon	[4]Pesticide
		One per week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	Metals-Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[5]Nutrients

NOTES

[1]Portion of complete sewage sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A.A. spectrophotometer test as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer tests as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Plant effluent	Effluent after post-chlorination at point where flow passes over discharge weir.	One each hour	24-hour grab composite weighted by flow (sample quantity shown allows for variance to two-thirds without limiting tests)	(composite total)	Settleable solids, pH, DO, Temp
		Thursday Friday Saturday Sunday Monday Tuesday Wednesday (Day to begin with 1:00 a. m. sample)		7 5-gallon	[1]Sewage solids
				7 2-quart	BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 2-quart (pres. in $HgCl_2$)	[5]Nutrients & COD
				7 1-gallon	Algae growth potential
		One at peak flow (plus one hour)	Grab	(Total each sample)	pH, DO, Temp
		Thursday Friday Saturday Sunday Monday Tuesday Wednesday		7 3-gallon	Floatables, grease, settleables, Turbidity, S.S.
				7 1-pint (pres in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-quart (pres. in $HgCl_2$)	Nutrients & COD
				2 2-gallon	[4]Pesticide
				7 100-ml (sterile bottle)	Bacteriological
		One per week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	Metals- Emission spectrograph
				1 1-quart (pres.in $HgCl_2$)	[5]Nutrients & COD

NOTES

[1]Portion of complete sewage sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1-pint for use in detailed A.A. spectrophotometer test as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer tests as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Raw sludge to Southeast Water Pollution Control Plant	Raw sludge force main to Southeast plant (from sample pipe off side of force main. Pipe to run continuously in sump)	One each hour	24-hour grab composite weighted by flow	(composite total)	pH, Temp
		Thursday Friday Saturday Monday Wednesday		5 2-quart (pres. in $HgCl_2$)	[1]COD
				5 1-pint (pres. in ZnAc)	Sulfides, total
				5 1-quart (pres. in acid)	[2]Metals
				5 1-gallon	Grease & solids
		Sunday Tuesday		2 2-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				2 1-pint (pres in ZnAc)	Sulfides, total
				2 2-gallon	Grease & solids
				2 1-quart (pres. in acid)	[2]Metals
				2 2-gallon	Pesticides
		One every 4 hours beginning at 4:30 a. m.	Grab	12 - 1/2 & 1-pint	[4]Solids & chlorine demand
		Sunday Tuesday		12 1-pint (pres in $HgCl_2$)	[4]COD
				12 - 1/2-pint (pres in ZnAc)	[4]Sulfides, total
				12 1-pint (pres in acid)	[4]Metals
		One at 8:00 a. m. Sunday Tuesday	Grab	2 2-gallon	[3]Chlorine demand
		One each hour Thursday	Grab	24 1/2-pint	Solids, total & volatile
		One per week	7-day composite weighted by flow	1 1-quart (pres. in $HgCl_2$)	Nutrients & COD
				1 1-quart (pres. in acid)	Metals - Emission spectrograph

NOTES

[1]COD run daily for a portion of sample. Remaining portion held for making up 7-day composite samples.

[2]Retain all samples for use in detailed A.A. spectrophotometer tests as required.

[3]Test run for determining Cl_2 demand only (as it relates to freshness of sewage at discharge point. Further, more detail examinations to be made as required.

[4]Samples to be perserved for possibe use of city in relation to URS study at SE plant.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Raw sludge from North Point Water Pollution Control Plant	Raw sludge just downstream of parshall flume in Southeast Water Pollution Control Plant	One each hour	24-hour grab composite weighted by flow	(composite total)	[1]pH, Temp.
		Thursday Friday Saturday Sunday Monday Tuesday Wednesday		7 1-quart (pres. in ZnAc)	Sulfides, total

NOTE

[1]To be run as often as possible by SE plant laboratory personnel.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Grit flow to washer	Discharge of collection funnel(s).	One each hour Daily	[1]24-hour grab composite	7 1-quart	[2]Solids, total and volatile.
		One per week	7-day composite	———	Sieve analysis
Grit overflow from washer	Discharge of overflow to influent channel	One each hour Daily	24-hour grab composite	7 1-quart	[2]Solids, total and volatile
		One per week	7-day composite	———	Sieve analysis

NOTES

[1]Grit flow to washer samples to be composited from unit in operation. If two units (washers) in operation amount composited shall be double.

[2]Ash of each day's sample shall be saved for weekly composite sieve analysis.

Process sampled	Sampling points	Day and type of samole	Tests to be performed
Sewage flow through plant	Grit channel Pump sump Pump discharge End preaeration tank Sedimentation tank effluent	Wednesday 1 grab sample at each point (following peak flow through plant)	Sulfides

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BROWN AND CALDWELL
CONSULTING ENGINEERS
SAN FRANCISCO - ALHAMBRA, CALIFORNIA

FILE F265E
DATE SEPT 1970

CITY AND COUNTY OF SAN FRANCISCO
REPORT ON WATER POLLUTION CONTROL PLANTS

NORTH POINT PLANT
SAMPLING AND ANALYSIS PROGRAM

SHEET NUMBER 1 OF 1

DRAWING NUMBER Fig. 3-1

Process sampled	Sampling point	Frequency ar week of s
Plant influent	Plant channel at diversion gate between grit tanks and primary sedimentation tanks. (special thief sampler)	One each
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday (Day to begi 1:00 a.m. s
		One at peak
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday
		One for wee

NOTES

[1]Portion of sewage solids sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A. A. spectrophotometer test as required.

[3]Retain all samples for use in detailed A. A. spectrophotometer tests as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

Process sampled	Sampling point	Frequency ar week of s
Raw sludge to digester from thickening tanks	Raw sludge force main sampling line (using standard dipper)	Even increme sump pump - Amount collec distributed eac to composite s
		Wednesday Thursday Friday Saturday Monday
		Sunday Tuesday
		One for week
Supernatant from thickening tanks to sedimentation tank influent	Supernatant force main sampling line (1 sample every 1' - 0 using standard dipper)	Daily - Collect same as for ra
Sewage flow through plant	Upstream of bar stream Influent sampling point Sed tank effluent launders	Tuesday

NOTES

[1]COD run daily and nutrient 2 days from portion of sample. Remaining portion held for making up 7-day composite samples.

[2]Retain all samples for use in making up 7-day composite sample and detailed daily A. A. spectrophotometer tests as required.

Type of sample	Number and size of sample	Tests to be performed on sample
4-hour grab composite eighted by flow sample quantity shown lows for variance to wo thirds without limiting sts)	(composite total)	Settleable solids, pH, DO, Temp.
	7 5-gallon	[1]Sewage solids BOD
	7 1-quart (pres. in acid)	[2]Metals
	7 3-gallon	Pesticide
	7 15-gallon	Bioassay
	7 1-quart (pres. in $CuSO_4$)	Phenols
	7 1-quart (pres. in $HgCl_2$)	[5]Nutrients and COD
Grab	(total each sample)	pH, DO, Temp
	7 3-gallon	Floatables, grease, settleables, Turbidity, Suspended solids, total and volatile
	7 1-pint (pres. in acid)	[3]Metals
	2 10-gallon	[4]Bioassay
	7 1-pint (pres. in $HgCl_2$)	Nutrients and COD
	2 2-gallon	[4]Pesticide
	7 100-ml (sterile bottle)	Bacteriological
7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
	1 1-quart (pres. in acid)	[2]Metals - Emission spectrograph
	1 1-quart (pres. in $HgCl_2$)	[5]Nutrients and COD
24-hour grab composite weighted by flow	(composite total)	Each hour - pH, Temp
	7 2-quart	Grease and solids, total and volatile Chlorides, Alkalinity
	7 1-pint (pres. in acid)	[1]Metals
8-hour grab composite weighted by flow	4 2-quart	Grease and solids, total and volatile Chlorides, Total iron
8-hour grab composite equal increments	4 1-quart	Grease and solids, total and volatile Moisture content, Metals
detail A. A. spectrophotometer.		
24-hour grab composite weighted by flow	(composite total)	Each hour S.S., pH, DO, Temp. (use 100 ml graduate for S.S.)
	7 5-gallon	[1]Sewage solids (turbidity on lab. settled) chlorides BOD
	7 1-pint (pres. in acid)	[2]Metals
	7 1-quart (pres. in $CuSO_4$)	Phenols
	7 1-quart (pres. in $HgCl_2$)	[3]Nutrients and COD
7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
	1 1-quart (pres. in acid)	[2]Metals - emission spectrograph
	1 1-quart (pres. in $HgCl_2$)	[3]Nutrients

DRAWN F.B.	DESIGNED Warren R White	APPROVED	CHMOND - SUNSET PLANT	SHEET NUMBER	DRAWING NUMBER
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OUTLINE OF SAMPLING AND ANALYSIS PROGRAM

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

AUGUST 12, 1970 TO AUGUST 18, 1970

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Plant influent	Plant channel at diversion gate between grit tanks and primary sedimentation tanks. (special thief sampler)	One each hour	24-hour grab composite weighted by flow (sample quantity shown allows for variance to two-thirds without limiting tests)	(composite total)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday (Day to begin with 1:00 a.m. sample)		7 5-gallon	[1]Sewage solids (turbidity on lab. settled) BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres in $CuSO_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[5]Nutrients and COD
		One at peak flow	Grab	(total each sample)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday		7 3-gallon	Floatables, grease, settleables, Turbidity (on lab. settled) Suspended solids, total and volatile
				7 1-pint (pres in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-pint (pres. in $HgCl_2$)	Nutrients and COD
				2 2-gallon	[4]Pesticide
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres in acid)	[2]Metals - Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[5]Nutrients
Raw sludge to digester from thickening tanks	Raw sludge force main sampling line (using standard dipper)	Even increments of sump pump - down - Amount collected distributed each hour to composite samples	24-hour grab composite weighted by flow	(composite total)	Each hour - pH, Temp
				5 2-quart (pres. in $HgCl_2$)	[1]COD
				5 2-quart (pres. in Zn Ac)	Sulfides, total
		Wednesday Thursday Friday Saturday Monday		5 2-quart (pres. in acid)	[2]Metals
				5 5-1/2-gallon	Grease and solids, total and volatile, Chlorides
		Sunday Tuesday		2 2-quart (pres in $HgCl_2$)	[1]Nutrients & COD
				2 2-quart (pres. in Zn Ac)	Sulfides, total
				2 2-quart (pres in acid)	[2]Metals
				2 1-1/2-gallon	Grease and solids, total and volatile, Chloride
		One for week	7-day composite weighted by flow	1 1-quart (pres in $HgCl_2$)	[1]Nutrients and COD
				1 1-quart (pres. in acid)	[2]Metals Emission spectro
Supernatant from thickening tanks to sedimentation tank influent	Supernatant force main sampling line (1 sample every 1' - 0 using standard dipper)	Daily - Collected the same as for raw sludge	24-hour grab composite weighted by flow	7 2-gallon	Grease and solids, total and volatile Chlorides
Sewage flow through plant	Upstream of bar stream Influent sampling point Sed tank effluent launders	Tuesday	1 grab sample at each point (following peak flow through plant)	3 1-quart	Sulfides

NOTES

[1]Portion of sewage solids sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A.A. spectrophotometer test as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer tests as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

NOTES

[1]COD run daily and nutrient 2 days from portion of sample. Remaining portion held for making up 7-day composite samples.

[2]Retain all samples for use in making up 7-day composite sample and detailed daily A.A. spectrophotometer tests as required.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Plant effluent	Effluent after postchlorination immediately downstream of mixing chamber	One each hour	24-hour grab composite weighted by flow (sample quantity shown allows for variance to two thirds without limiting tests)	(composite total)	Settleable solids, pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday (Day to begin with 1:00 a.m. sample)		7 5-gallon	[1]Sewage solids BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres in $HgCl_2$)	[5]Nutrients and COD
		One quart peak flow (plus 1 hour)	Grab	(total each sample)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday		7 3-gallon	Floatables, grease, settleables, Turbidity, Suspended solids, total and volatile
				7 1-pint (pres. in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-pint (pres in $HgCl_2$)	Nutrients and COD
				2 2-gallon	[4]Pesticide
				7 100-ml (sterile bottle)	Bacteriological
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals - Emission spectrograph
				1 1-quart (pres in $HgCl_2$)	[5]Nutrients and COD
Digested supernatant and sludge to elutriation system	Digested sludge force main at discharge to mixer-let sampling line run continuously	One each hour	24-hour grab composite weighted by flow	(composite total)	Each hour - pH, Temp
		Daily		7 2-quart	Grease and solids, total and volatile Chlorides, Alkalinity
				7 1-pint (pres. in acid)	[1]Metals
Liquid waste from filters (filtrate)	Flow measuring box	One each hour during time filter in operation	8-hour grab composite weighted by flow	4 2-quart	Grease and solids, total and volatile Chlorides, Total Iron
Sludge filter cake	Conveyor belt just after flow from two filters becomes one	Assumed 8-hour runs 4 days a week (Mon through Thurs)	8-hour grab composite equal increments	4 1-quart	Grease and solids, total and volatile Moisture content, Metals

NOTES

[1]Portion of sewage solid sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A.A. spectrophotometer analysis as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer analysis as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

NOTE [1]Samples retained for examination, as required, by detail A.A. spectrophotometer.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Elutriation overflow to influent sewer	Elutriation overflow into pipe	One each hour	24-hour grab composite weighted by flow	(composite total)	Each hour S.S., pH, DO, Temp. (use 100 ml graduate for S.S.)
		Daily		7 5-gallon	[1]Sewage solids (turbidity on lab. settled) chlorides BOD
				7 1-pint (pres in acid)	[2]Metals
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres in $HgCl_2$)	[3]Nutrients and COD
		1 for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals - emission spectrograph
				1 1-quart (pres in $HgCl_2$)	[3]Nutrients

NOTES

[1]Portion of sewage solids sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint of each day for use in detailed AA spectrophotometer tests as required.

[3]Portion of daily nutrients to be retained for making 7-day composite for complete nutrient analysis.

DRAWN E.B. / CHECKED W.P.	DESIGNED Warren R White / SUBMITTED	APPROVED ___ Date / APPROVED ___ Date	BROWN AND CALDWELL CONSULTING ENGINEERS SAN FRANCISCO - ALHAMBRA, CALIFORNIA	FILE F 265E / DATE SEPT 1970	CITY AND COUNTY OF SAN FRANCISCO REPORT ON WATER POLLUTION CONTROL PLANTS
RICHMOND-SUNSET PLANT SAMPLING AND ANALYSIS PROGRAM	SHEET NUMBER 1 OF 1	DRAWING NUMBER Fig. 3-2			

Process sampled	Sampling point	Frequency a week of	Type of sample	Number and size of sample	Tests to be performed on sample
Plant influent	Immediately downstream of raw sewage coarse bar rack	One every 2	?4-hour grab composite veighted by flow sample quantity shown llows for variance to wo-thirds without limiting ests).	(composite total)	Settleable solids, pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday (Day to begir 1:00 a.m. sa		7 5-gallon	[1]Sewage solids BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[5]Nutrients and COD
		One at peak	Grab	(total each sample)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday		7 3-gallon	Floatables, grease, settleables Turbidity, Suspended solids, total and volatile
				7 1-pint (pres. in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-pint (pres. in $HgCl_2$)	Nutrients and COD
				2 2-gallon	[4]Pesticide
				7 100 ml (sterile bottle)	Bacteriological
		One for wee	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals Emission spectrophotometer
				1 1-quart (pres. in $HgCl_2$)	[5]Nutrients & COD
Thickening tank over-flow to southeast water pollution control plant grit tank inflow.	Just upstream of entrance to discharge pipe at end of trough	One every 2 h	24-hour grab composite weighted by flow (composite hourly samples for each tank into one by flow)	(composite total)	Each hour S.S., pH, temperature
		Daily		7 5-gallon	[1]Sewage solids (turbidity on lab settled sample) Chlorides BOD
				7 1-pint (pres. in acid)	[2]Metals
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[3]Nutrients and COD
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[3]Nutrients
Sewage flow through plant	Upstream of bar stream Pump discharge chamber Influent to sedimentation tanks Sedimentation tank effluent just upstream of trough overflow	Tuesday			

NOTES (Plant influent)

[1]Portion of sewage solids sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A.A. spectrophotometer analysis, as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer analysis as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

NOTES (Thickening tank overflow)

[1]Portion of sewage solids samples to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite retain at least 1 pint of each day for use in detailed A.A. spectrophotometer tests as required.

[3]Portion of daily nutrients to be retained for making 7-day composite for complete nutrient analysis.

DRAWN T.B. CHECKED WRU	DESIGNED Warren White SUBMITTED [illegible]	APPROVED APPROVED	SOUTHEAST PLANT NG AND ANALYSIS PROGRAM	SHEET NUMBER 1 OF 2	DRAWING NUMBER Fig. 3-3

OUTLINE OF SAMPLING AND ANALYSIS PROGRAM
SOUTHEAST WATER POLLUTION CONTROL PLANT
AUGUST 26, 1970 TO SEPTEMBER 1, 1970

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Plant influent	Immediately downstream of raw sewage coarse bar rack	One every 2 hours	24-hour grab composite weighted by flow (sample quantity shown allows for variance to two-thirds without limiting tests)	(composite total)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday (Day to begin with 1:00 a.m. sample)		7 5-gallon	[1]Sewage solids (turbidity on lab. settled solids) BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[5]Nutrients and COD
		One at peak flow	Grab	(total each sample)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday		7 3-gallon	Floatables Grease Settleables Turbidity (on lab settleable) Suspended solids, total and volatile
				7 1-pint (pres. in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-pint (pres. in $HgCl_2$)	Nutrients and COD
				2 2-gallon	[4]Pesticide
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[5]Nutrients
Thickening tank overflow to southeast water pollution control plant grit tank inflow.	Just upstream of entrance to discharge pipe at end of trough	One every 2 hours	24-hour grab composite weighted by flow	(composite total)	Each hour S.S., pH, temperature
		Daily		7 5-gallon	[1]Sewage solids (turbidity on lab settled sample) Chlorides BOD
				7 1-pint (pres. in acid)	[2]Metals
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[3]Nutrients and COD
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[3]Nutrients
Sewage flow through plant	Upstream of bar stream Pump discharge chamber Influent to sedimentation tanks Sedimentation tank effluent just upstream of trough overflow	Tuesday	One grab sample at each point (following peak flow through plant)	4 1-quart	Sulfides

NOTES

[1]Portion of sewage solids sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A.A. spectrophotometer analysis, as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer analysis as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for making 7-day composite for complete nutrient analysis.

NOTES

[1]Portion of sewage solids samples to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite retain at least 1 pint of each day for use in detailed A.A. spectrophotometer tests as required.

[3]Portion of daily nutrients to be retained for making 7-day composite for complete nutrient analysis.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of sample	Tests to be performed on sample
Plant effluent	Sedimentation tank effluent prior to post-chlorination	One every 2 hours	24-hour grab composite weighted by flow (sample quantity shown allows for variance to two-thirds without limiting tests).	(composite total)	Settleable solids, pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday (Day to begin with 1:00 a.m. sample)		7 5-gallon	[1]Sewage solids BOD
				7 1-quart (pres. in acid)	[2]Metals
				7 3-gallon	Pesticide
				7 15-gallon	Bioassay
				7 1-quart (pres. in $CuSo_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[5]Nutrients and COD
		One at peak flow (plus one hour)	Grab	(total each sample)	pH, DO, Temp
		Wednesday Thursday Friday Saturday Sunday Monday Tuesday		7 3-gallon	Floatables, grease, settleables Turbidity, Suspended solids, total and volatile
				7 1-pint (pres. in acid)	[3]Metals
				2 10-gallon	[4]Bioassay
				7 1-pint (pres. in $HgCl_2$)	Nutrients and COD
				2 2-gallon	[4]Pesticide
				7 100 ml (sterile bottle)	Bacteriological
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals Emission spectrophotometer
				1 1-quart (pres. in $HgCl_2$)	[5]Nutrients & COD
Elutriation tank overflows to southeast water pollution control plant grit tank inflow	Just upstream of entrance to discharge pipe at end of trough (one for tank 2 and tank 3)	One every 2 hours	24-hour grab composite weighted by flow (composite hourly samples for each tank into one by flow)	(composite total)	Each hour S.S., pH, temperature
		Daily		7 5-gallon	[1]Sewage solids (turbidity on lab settled sample) Chlorides BOD
				7 1-pint (pres. in acid)	[2]Metals
				7 1-quart (pres. in $CuSO_4$)	Phenols
				7 1-quart (pres. in $HgCl_2$)	[3]Nutrients and COD
		One for week	7-day composite weighted by flow	1 2-gallon	[1]Complete mineral
				1 1-quart (pres. in acid)	[2]Metals Emission spectrograph
				1 1-quart (pres. in $HgCl_2$)	[3]Nutrients

NOTES

[1]Portion of sewage solid sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1 pint for use in detailed A.A. spectrophotometer analysis, as required.

[3]Retain all samples for use in detailed A.A. spectrophotometer analysis, as required.

[4]Samples to be collected only on Sunday and Tuesday.

[5]Portion of nutrients to be retained for complete nutrient analysis.

NOTES

[1]Portion of sewage solids sample to be retained for making 7-day composite for complete mineral analysis.

[2]All composited metal samples to be retained. Use portion of each sample for making 7-day composite, retain at least 1-pint of each day for us in detailed A.A. spectrophotometer tests as required.

[3]Portion of daily nutrients to be retained for making 7-day composite for complete nutrient analysis.

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Process sampled	Sampling point	Frequency and week of sa
Raw sludge from North Point Water Pollution Control Plant	Raw sludge just down-stream of parshall flume	One every 2
		Wednesday Thursday Friday Saturday Monday
		Sunday Tuesday
		One for week

NOTES

[1]COD run daily and nutrients only 2 days listed from portion of sample. Remaining portions held for making up 7-day composite samples.

[2]Retain all samples for use in making up 7-day composite sample and detailed A.A. spectrophotometer analysis, as required.

Process sampled	Sampling point	Frequency and week of sa
Raw sludge from Southeast plant	Raw sludge just down-stream of parshall flume	One every 2 h
		Wednesday Thursday Friday Saturday Monday
		Sunday Tuesday
		One for week

. NOTES

[1]COD run daily and nutrients only 2 days listed from portion of sample. Remaining portions held for making up 7-day composite samples.

[2]Retain all samples for use in making up 7-day composite sample and detailed A.A. spectrophotometer analysis, as required.

Type of sample	Number and size of samples	Tests to be performed on sample
-hour grab composite ual amounts	(composite total)	pH, Temperature
	5 1-quart (pres. in $HgCl_2$)	[1]COD
	5 1-pint (pres. in ZnAc)	Sulfides, total
	5 1-quart (pres. in acid)	[2]Metals
	5 2-quart	Grease Solids, total and volatile Chlorides
	2 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
	2 1-pint (pres. in ZnAc)	Sulfides, total
	2 1-quart (pres. in acid)	[2]Metals
	2 2-quart	Grease Solids, total and volatile Chlorides
'-day composite veighted by flow	1 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
	1 1-quart (pres. in acid)	[2]Metals Emission spectrograph
-hour grab composite ual quantities	(composite total)	pH, Temperature
	7 2-quart	Grease Solids, total and volatile Chlorides Alaklinity
	7 1-pint (pres. in acid)	[5]Metals
2- to 24-hour grab omposite qual quantities	7 2-quart	Grease Solids, total and volatile Chlorides
	7 1-pint (pres. in acid)	[5]Metals
- to 24-hour grab mposite ual increments of grams	7 1-quart (approximate)	Weight Grease, solids, total and volatile Moisture content [5]Metals
Surface grab	Each sample in field	pH, DO, Temp., Salinity, Turbidity
	Each sample in lab	
	49 1-gallon	Turbidity, Floatables
	49 1-quart (pres. in acid)	[1]Metals
	49 1-quart (pres. in $HgCl_2$)	[2]Nutrients and COD
	14 10-gallons	[3]Bioassay
	14 2-quart	[3,4]BOD and grease
	14 1-100 ml sterile bottle	[3]Bacteriological
Surface grab	Each sample in field	Salinity, pH, DO, Temp.
	Each sample in lab	
	8 1-gallon	Turbidity, Floatables
	8 1-quart (pres. in acid)	[5]Metals
	8 1-quart (pres. in $HgCl_2$)	Nutrients
7-day composite in equal increments	2 1-quart (pres. in acid)	Metals - Emission spectrograph

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SOUTHEAST PLANT
G AND ANALYSIS PROGRAM

SHEET NUMBER 2 OF 2 DRAWING NUMBER Fig. 3-3

OUTLINE OF SAMPLING AND ANALYSIS PROGRAM
SOUTHEAST WATER POLLUTION CONTROL PLANT
AUGUST 26, 1970 TO SEPTEMBER 1, 1970

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Raw sludge from North Point Water Pollution Control Plant	Raw sludge just downstream of parshall flume	One every 2 hours	24-hour grab composite weighted by flow	(composite total)	pH, Temperature
		Wednesday Thursday Friday Saturday Monday		5 1-quart (pres. in $HgCl_2$)	[1]COD
				5 1-pint (pres. in ZnAc)	Sulfides, total
				5 1-quart (pres. in acid)	[2]Metals
				5 2-quart	Grease Solids, total and volatile Chlorides
		Sunday Tuesday		2 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				2 1-pint (pres. in ZnAc)	Sulfides, total
				2 1-quart (pres. in acid)	[2]Metals
				2 2-quart	Grease Solids, total and volatile Chlorides
		One for week	7-day composite weighted by flow	1 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				1 1-quart (pres. in acid)	Metals Emission spectrograph

NOTES

[1]COD run daily and nutrients only 2 days listed from portion of sample. Remaining portions held for making up 7-day composite samples.

[2]Retain all samples for use in making up 7-day composite sample and detailed A.A. spectrophotometer analysis, as required.

Process sampled	Sampling point	Frequency and day of week of sample	Type of sample	Number and size of samples	Tests to be performed on sample
Raw sludge from Southeast plant	Raw sludge just downstream of parshall flume	One every 2 hours	24-hour grab composite weighted by flow	(composite total)	pH, Temperature
		Wednesday Thursday Friday Saturday Monday		5 1-quart (pres. in $HgCl_2$)	[1]COD
				5 1-pint (pres. in ZnAc)	Sulfides, total
				5 1-quart (pres. in acid)	[2]Metals
				5 2-quart	Grease Solids, total and volatile Chlorides
		Sunday Tuesday		2 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				2 1-pint (pres. in ZnAc)	Sulfides, total
				2 1-quart (pres. in Acid)	[2]Metals
				2 2-quart	Grease Solids, total and volatile Chlorides
		One for week	7-day composite weighted by flow	1 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				1 1-quart (pres. in acid)	[2]Metals Emission spectrograph

NOTES

[1]COD run daily and nutrients only 2 days listed from portion of sample. Remaining portions held for making up 7-day composite samples.

[2]Retain all samples for use in making up 7-day composite sample and detailed A.A. spectrophotometer analysis, as required.

Process sampled	Sampling point	Frequency and day of week of samples	Type of sample	Number and size of samples	Tests to be performed on sample
Thickened sludge to digester	Sampling line in pump room of thickener build	One every 2 hours	24-hour grab composite equal amounts	(composite total)	pH, Temperature
		Wednesay Thursday Friday Saturday Monday		5 1-quart (pres. in $HgCl_2$)	[1]COD
				5 1-pint (pres. in ZnAc)	Sulfides, total
				5 1-quart (pres. in acid)	[2]Metals
				5 2-quart	Grease Solids, total and volatile Chlorides
		Sunday Tuesday		2 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				2 1-pint (pres. in ZnAc)	Sulfides, total
				2 1-quart (pres. in acid)	[2]Metals
				2 2-quart	Grease Solids, total and volatile Chlorides
		One for week	7-day composite weighted by flow	1 1-quart (pres. in $HgCl_2$)	[1]Nutrients and COD
				1 1-quart (pres. in acid)	[2]Metals Emission spectrograph
Digested sludge to elutriation system	Digested sludge at elutriation tank mixing box. (For tanks No. 1 and No. 4)	One every 2 hours	24-hour grab composite equal quantities	(composite total)	pH, Temperature
		Daily		7 2-quart	Grease Solids, total and volatile Chlorides Alaklinity
				7 1-pint (pres. in acid)	[5]Metals
Elutriation sludge from concentration tank	Sampling tap on force main to filters	During time filter in operation	12- to 24-hour grab composite equal quantities	7 2-quart	Grease Solids, total and volatile Chlorides
				7 1-pint (pres. in acid)	[5]Metals
Sludge filter cake	Conveyor belt just before it discharges to inclined belt to hopper	During time filter in operation	12- to 24-hour grab composite equal increments of 8 grams	7 1-quart (approximate)	Weight Grease, solids, total and volatile Moisture content [5]Metals
Receiving waters	Cal. State grid points 0 - 2 N2 - 4 0 - 7 S2 - 4 Two floating points (as selected each trip from following four) C, N5-6, S7-6, 0-10	One sample each day at daylight low water slack	Surface grab	Each sample in field	pH, DO, Temp., Salinity, Turbidity
				Each sample in lab	
				49 1-gallon	Turbidity, Floatables
				49 1-quart (pres. in acid)	[1]Metals
				49 1-quart (pres. in $HgCl_2$)	[2]Nutrients and COD
				14 10-gallons	[3]Bioassay
				14 2-quart	[3,4]BOD and grease
				14 1-100 ml sterile bottle	[3]Bacteriological
Receiving waters	Cal. State grid points 0 - 2 N2 - 4 0 - 7 S2 - 4	One sample Sunday and Tuesday at lower low water slack	Surface grab	Each sample in field Salinity, pH, DO, Temp.	
				Each sample in lab	
				8 1-gallon	Turbidity, Floatables
				8 1-quart (pres. in acid)	[5]Metals
				8 1-quart (pres. in $HgCl_2$)	Nutrients
Receiving waters	Cal. State grid points 0 - 2, 0 - 7	One for week each grid point	7-day composite in equal increments	2 1-quart (pres. in acid)	Metals - Emission spectrograph

NOTES

1. Use portion of sample for weekly composite, save remaining portion for detailed A.A. spectrophotometer analysis as required.
2. Nutrient on all samples. COD's grid points 0-2 and floating point.
3. Grid points 0-2 and floating point.
4. Measure one day BOD as well as five-day BOD.
5. Save sample for detailed A.A. spectrophotometer analysis as required.

Drawn F.B. Checked [illegible]	Designed [illegible] Submitted [illegible]	Approved ____ Date Approved ____ Date	BROWN AND CALDWELL CONSULTING ENGINEERS SAN FRANCISCO - ALHAMBRA, CALIFORNIA	FILE F-265E DATE SEPT 1970	CITY AND COUNTY OF SAN FRANCISCO REPORT ON WATER POLLUTION CONTROL PLANTS	SOUTHEAST PLANT SAMPLING AND ANALYSIS PROGRAM	SHEET NUMBER 2 of 2	DRAWING NUMBER Fig. 3-3

duced during later plant determinations to be more comparable with plant laboratory tests. Laboratory techniques used for all tests are given in Appendix B.

Results of the receiving water bacteriological analyses and complete mineral analyses of plant flows are included in the appendices. Sampling irregularities negated all effluent bacteriological analyses. These tests were included in the sampling program to provide more comprehensive results, but are not really necessary to this phase of the study.

NORTH POINT WATER POLLUTION CONTROL PLANT

The North Point plant was selected to be the first plant to be sampled because of its relatively minimal solids handling facilities. The process flows sampled at the North Point plant included influent, effluent and raw sludge. In addition, the discharge of the North Point sludge force main at the Southeast plant was sampled, as were the grit flow to the grit washer and the grit washer overflow. All points were sampled hourly and composited on a flow weighted basis into chilled collection vessels. Peak flow grab samples were collected from the influent and effluent and seven-day samples were composited on a flow basis from the daily composited samples of influent, effluent and raw sludge. Special grab sampling programs were developed for raw sludge to ascertain the chlorine demand of the sludge for various detention periods in the sludge force main.

Loadings - Sewage Treatment

Laboratory data sheets with the complete results of the North Point influent and effluent sampling and analysis program are attached as part of Appendix C-1. Table 3-4 shows those influent and effluent solids loadings which can be meaningfully expressed in total pounds per day. Fig. 3-4 shows plots of the influent and effluent flow, dissolved oxygen, pH, temperature and settleable solids measurement made in the field by the sampling personnel. Plotted flows reflect the measurements indicated at the time of sampling. Daily total flow figures used in Table 3-4 were provided by the plant staff and reflect an extensive meter calibration program which is continually updated. Table 3-5 shows nutrients and pesticides loadings while Table 3-6 gives the contents of specific metal elements in the seven-day composite samples based upon semi-quantitative spectrographic analyses. All loads are again expressed in pounds per day.

As can be seen on Fig. 3-4, North Point's diurnal flow variation during the sampling period reflects normal dry weather conditions. Average influent sewage flow for the week at 59 mgd was slightly below the plant's design average flow of 65 mgd. The average daily peak of 79 mgd and the average daily minimum of 30 mgd are normal variations. Even the fact that the maximum peak of 85 mgd came at 12 noon on Thursday isn't particularly surprising when it is realized that the flow to this plant originates mostly from the major downtown commercial area of San Francisco. This also helps to explain the Sunday noon minimum peak flow of 68 mgd and the lack of any significant difference between each day's minimum flow, either in quantity or hour of arrival.

The two flow determinations shown on Fig. 3-4 result from the plant having both influent and effluent meters and its discharge of a significant flow of raw sludge to the Southeast treatment plant. The difference between the flow figures reflects both the effect of the raw sludge removal and inherent meter inaccuracies.

Sewage entering the North Point plant is very fresh as shown by the high level of dissolved oxygen in the plant influent. At no time during the sampling period did the influent dissolved oxygen level drop below 1 mg/l while the weekly average was well above 2 mg/l. Sewage temperature and pH fluctuations were normal with the average influent temperature about 24°C and the average influent pH slightly below 7.0. In both cases, effluent averages are slightly lower, reflecting the plant detention period. Effluent settleable solids concentrations pretty much paralleled the flow variations, with concentrations exceeding 1 ml/l/hr at periods of peak flow on almost every day. Only on Saturday did the concentrations of settleable solids stay well below this critical level.

In almost every case daily plant loading shown in Tables 3-4 and 3-5 dropped significantly on Saturday and Sunday. The exceptions were the sludge force main exit sulfides and most of the pesticides. The sludge force main exit sulfides actually increased slightly on the weekend, no doubt reflecting the longer detention period of the slightly lower flows. Total solids in the effluent are affected by the leakage of salt water into low or empty sumps within the plant and these values cannot be relied upon to indicate plant performance. Pesticides loadings were so small the daily fluctuations could easily be explained by analysis variation. North Point sewage on a whole is a relatively weak commercial-domestic sewage.

Metallic and other trace elements found in the seven-day composites of influent, effluent and raw sludge (Table 3-6) were found to be at normal levels for commercial and domestic sewage. No unusual concentrations of harmful or toxic metals were found although the lead level in the effluent was significantly higher than is presently being ac-

cepted by the Regional Board in receiving waters of the upper bay. The presence of mercury, not determinable by emission spectrography, was checked by the Federal Water Quality Administration in August 1970. Their report, submitted to the State Water Quality Control Board, shows a value of 0.0016 mg/l for a 24-hr effluent composite and 0.029 mg/l for a raw sludge grab sample.

Grit Removal

Table 3-7 shows the results of the North Point grit system sampling and analysis program. The erratic figures in these results reflect both the dif-

Table 3-4 Volume and Loadings of Influent, Effluent and Raw Sludge - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day average
Flow, mgd								
Influent	63.4	62.1	54.2	50.7	61.1	60.4	41.4	59.0
Effluent	61.0	61.9	52.7	50.3	59.7	59.3	60.0	57.8
Raw sludge	0.87	0.84	0.82	0.81	0.97	0.87	0.85	0.86
Total solids, 1,000 lb/day								
Influent	690	670	590	550	660	650	610	640
Effluent	660	670	570	550	-	590	600	620[a]
Raw sludge	72	50	57	59	89	72	92	73
Total volatile solids, 1,000 lb/day								
Influent	310	310	260	140	190	190	170	230
Effluent	200	170	140	110	170	140	190	160
Raw sludge	51	50	46	44	66	53	69	54
Total suspended solids, 1,000 lb/day								
Influent	100	100	72	68	-	110	120	95[a]
Effluent	39	57	-	28	45	54	-	45[b]
Volatile suspended solids, 1,000 lb/day								
Influent	85	88	59	59	-	-	110	80[b]
Effluent	32	42	33	24	42	-	65	40[a]
Floatables, 1,000 lb/day								
Influent	0.21	0.15	0	-	0.92	1.80	5.10	
Effluent	1.0	0.15	0	0.63	1.0	2.9	1.3	
Grease, 1,000 lb/day								
Influent	36	34	24	16	31	-	34	29[a]
Effluent	18	21	8	15	20	27	22	19
Raw sludge	15	8.7	4.5	2.2	12	13	41	14
BOD, 1,000 lb/day								
Influent	110	98	77	68	110	110	110	97
Effluent	86	83	57	50	80	89	85	76
COD, 1,000 lb/day								
Influent	280	190	210	170	280	260	-	240[a]
Effluent	170	190	150	110	190	150	130	160
Raw sludge	87	77	61	59	97	94	99	82
Sodium chloride, 1,000 lb/day								
Influent	450	400	390	350	-	410	430	410[a]
Effluent	450	440	400	390	700	440	410	460
Raw sludge	8.7	10	12	10	11	12	11	11
Sulfides, 1,000 lb/day								
Raw sludge								
Entry force main	0.10	0.14	0.04	0.04	0.28	0.07	0.48	0.16
Exit force main	0.29	0.25	0.30	0.34	0.26	0.33	0.14	0.27

[a] 6-day average. [b] 5-day average.

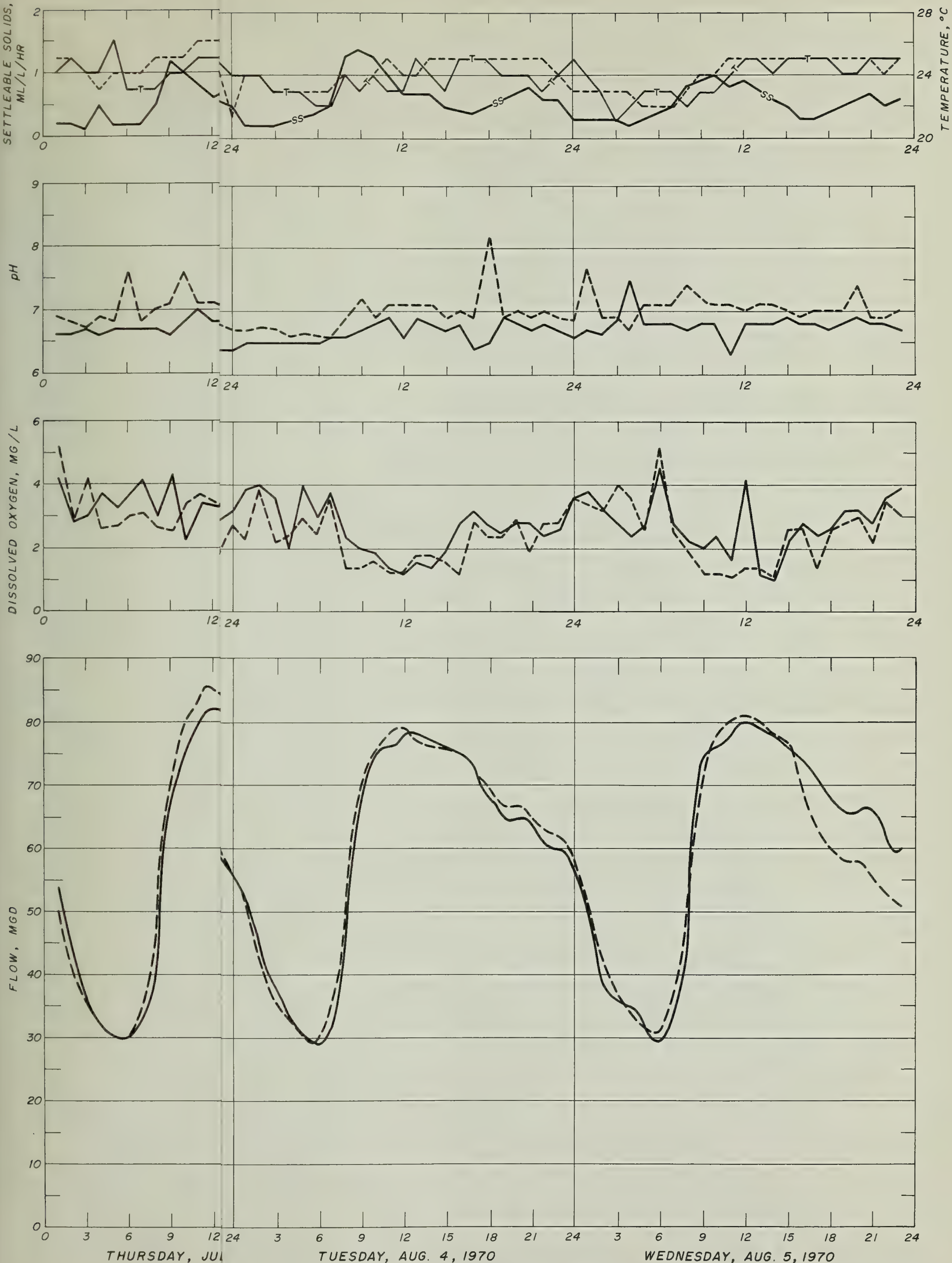

Fig. 3-4 **Hourly Variation in Influent and Effluent Flow, Dissolved Oxygen, pH and Temperature and Effluent Settleable Solids - North Point Plant**

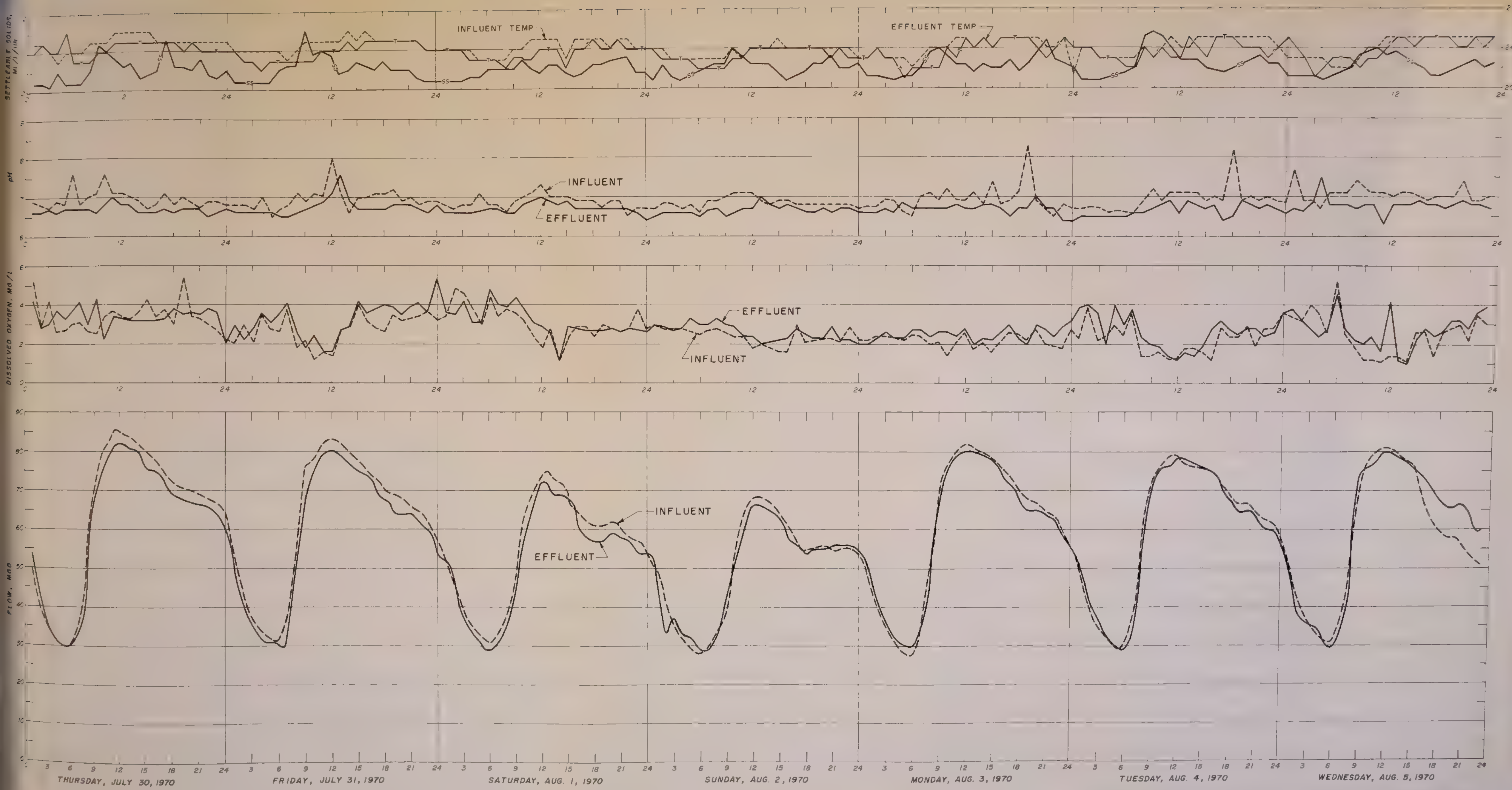

Fig. 3-4 **Hourly Variation in Influent and Effluent Flow, Dissolved Oxygen, pH and Temperature and Effluent Settleable Solids - North Point Plant**

Table 3-5 Nutrients and Chlorinated Hydrocarbon Pesticides Loadings of Influent, Effluent and Raw Sludge - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day
Total nitrogen, 1,000 lb/day								
Influent	16	18	15	14	19	16	18	17[a]
Effluent	13	17	13	12	18	14	16	15[a]
Raw sludge	2.7	2.7	2.2	2.4	2.8	2.2	2.5	2.5[a]
Tota phosphorus,[d] 1,000 lb/day								
Influent	14	13	12	12	15	16	13	14[a]
Effluent	13	13	11	11	14	12	13	12[a]
Raw sludge	1.4	1.5	1.2	1.1	1.5	1.5	1.9	1.4[a]
Phenols, lb/day								
Influent	38	35	24	13	29	32	24	28[a]
Effluent	39	32	19	8.0	22	55	22	28[a]
Lindane, lb/day								
Influent	-	0.02	0.06	0.04	0.06	0.09	-	0.27[c]
Effluent	0.04	0.03	0.04	0.04	0.04	0.11	-	0.26[c]
Raw sludge	-	-	-	0.01	-	0.006	-	-
Heptachlor-epoxide, lb/day								
Influent	<0.005	<0.005	<0.005	<0.004	<0.005	0.03	<0.005	-
Effluent	<0.005	<0.005	<0.004	<0.004	<0.005	<0.005	<0.005	-
Raw sludge	-	-	-	<0.0004	-	<0.0004	-	-
DDE, lb/day								
Influent	0.03	0.10	0.08	0.03	0.08	0.07	0.03	0.42[b]
Effluent	0.02	0.08	0.02	0.08	0.01	0.08	0.02	0.31[b]
Raw sludge	-	-	-	0.01	-	0.008	-	-
DDD, lb/day								
Influent	0.07	0.05	0.07	0.03	0.06	0.01	0.03	0.32[b]
Effluent	0.04	0.07	0.08	0.04	0.07	0.05	0.05	0.40[b]
Raw sludge	-	-	-	0.05	-	0.04	-	-
DDT, lb/day								
Influent	<0.025	<0.025	<0.025	0.06	<0.025	0.07	<0.025	-
Effluent	0.04	<0.025	<0.020	<0.020	<0.025	0.04	<0.025	-
Raw sludge	-	-	-	0.01	-	0.01	-	-
Dieldrin, lb/day								
Influent	0.03	0.07	0.05	0.05	0.03	0.04	0.04	0.31[b]
Effluent	0.02	0.06	0.04	0.04	0.06	0.03	0.02	0.27[b]
Raw sludge	-	-	-	0.01	-	0.02	-	-
TICH, lb/day								
Influent	-	0.24	0.26	0.21	0.23	0.31	-	1.25[b]
Effluent	0.16	0.24	0.18	0.21	0.18	0.31	-	1.22[b]
Raw sludge	-	-	-	0.09	-	0.08	-	-

[a] 7-day average.

[b] 7-day sum.

[c] 5-day sum.

[d] Expressed as PO_4.

ficulties involved in obtaining truly representative grit samples and the relative ineffectiveness of the existing grit removal system.

Receiving Waters

No separate receiving water sampling or analysis was done as part of this study of the North Point plant. The receiving water results to be used in Phase II of this study will be the conclusion of a separate study of the bay and ocean receiving waters being conducted concurrently with this study.

Loadings - Solids Treatment

Laboratory data sheets with the complete results of the North Point solids sampling and analy-

Table 3-6 Metallic and Other Trace Elements in 7-Day Composite Samples of Influent, Effluent and Raw Sludge - North Point Plant

	Influent		Effluent		Raw sludge	
	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day
Iron'	2.5	1,200	1.9	900	39	280
Copper	0.17	83	0.19	90	5.2	38
Nickel	0.017	8.3	0.092	45	0.26	1.9
Chromium	0.08	41	0.19	90	1.57	11
Lead	0.25	120	0.28	130	0.78	5.6
Tin	0.017	8.3	0.19	9.0	0.52	3.7
Zinc	0.34	170	0.28	130	-	-
Cobalt	0.008	< 4.0	0.009	< 4.0	0.026	< 0.2
Molybdenum	< 0.008	< 4.0	< 0.008	< 4.0	0.052	0.4
Silver	0.008	4.1	0.009	4.5	0.52	3.7
Vanadium	0.017	8.3	0.028	13	0.13	0.9
Titanium	0.50	250	0.28	130	4.2	30
Bismuth	0.080	< 4.0	< 0.008	< 4.0	0.052	0.4
Strontium	0.42	210	0.46	220	1.3	9.4
Zirconium	0.030	12	0.03	13	0.16	1.1
Boron	0.84	410	0.92	450	2.6	19
Barium	0.25	120	0.18	90	5.2	37
Antimony	-	-	-	-	0.52	3.7

Table 3-7 Grit System Sampling Results - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5
	Grit flow to washer						
Total solids, mg/l (NaCl corrected)	520	510	640	850	800	980	830
Volatile solids, mg/l	280	230	450	700	610	860	980
Volatile solids, Percent of total solids	55	45	69	82	77	87	-
	Grit washer overflow						
Total solids, mg/l (NaCl corrected)	510	590	770	610	460	540	460
Volatile solids, mg/l	260	240	480	470	700	400	400
Volatile solids, Percent of total solids	52	41	63	77	-	74	87
	Percent removed						
Total solids, percent (NaCl corrected)	1	-	-	28	43	45	56
Volatile solids, percent	6	-	-	33	-	54	59

sis program are attached as part of Appendix C-1 to this report. Solids, nutrients, pesticides, and metal loadings of the raw sludge samples are included in Tables 3-4, 3-5, and 3-6, respectively. Fig. 3-5 shows plots of the raw sludge and force main discharge sludge flow, pH and temperature. Plotted flows reflect the measurements indicated at the time of sampling.

Raw sludge flow, as indicated on Fig. 3-5, held fairly steady near its weekly average of 860,000 gpd during the entire sampling period. routine flushing of the force main on Monday accounts for that day's higher total flow of 970,000 gallons and its peak instantaneous flow of 1.38 mgd. As might be expected the minimum total raw sludge flow falls on Sunday, reflecting the lower sewage flows of that day. Although there is some hourly variation in raw sludge flow it is not as significant in magnitude as the hourly sewage flow variations. Both pH and temperature levels of the raw sludge were lower than similar sewage effluent levels indicating the effect of the longer sludge detention period within

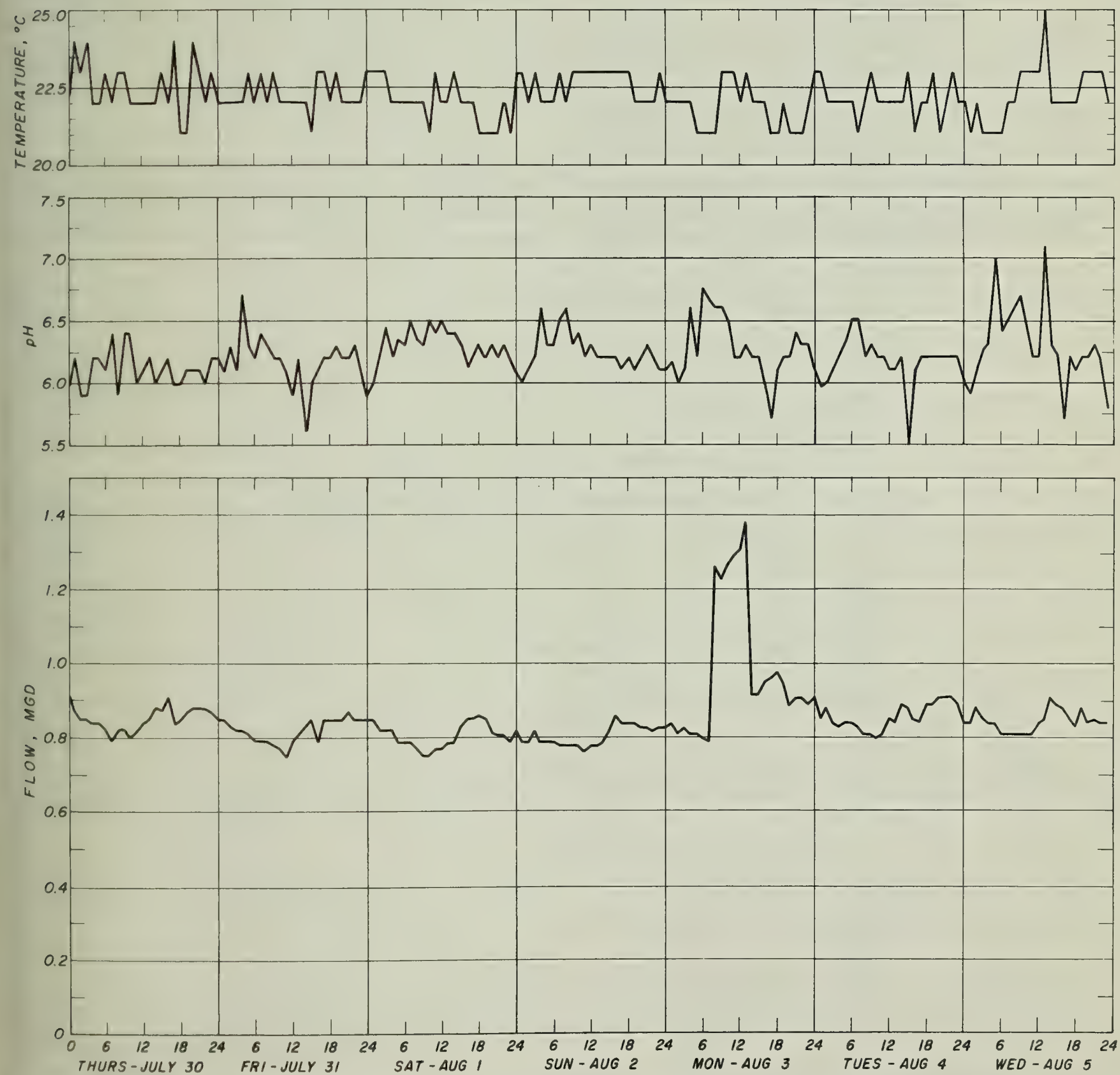

Fig. 3-5 Hourly Variation in Raw Sludge Flow, pH and Temperature - North Point Plant

the system.

Fig. 3-6 graphically shows the results of the extended time chlorine demand analyses of the raw sludge. These analyses were made to determine the quantity of chlorine required to maintain fresh sludge conditions in the force main to the Southeast plant. The results indicate that the sludge chlorine demand can be met for up to four hours of detention with a chlorine dosage of approximately 65 mg/l.

Mass Distribution

A review of the plant flow diagram, Fig. 2-2, indicates that for the North Point plant the only calcuable mass distribution involves the relationship among the plant influent, effluent and raw sludge systems. Table 3-8 shows the results of these calculations for applicable solids and nutrient measurements. In most cases the mass in closely equals the mass out thereby indicating that the North Point plant is not recirculating any significant amount of solids and that all of the solids being removed from the sewage are included in the raw sludge being transferred to the Southeast plant.

Comparisons with Routine Analyses

Tables 3-9, 3-10, and 3-11 tabulate daily composite results over the sampling period for those influent, effluent and raw sludge analyses which coincide with the routine laboratory analyses performed by plant personnel during the sampling period. Review of these comparisons indicates that all except the influent and effluent suspended solids and the influent BOD fall within expected sampling and laboratory techniques and tolerances. Study results of both influent and effluent suspended solids are significantly higher than similar plant measurements although the percent removed is approximately the same. Several reasons for these differences have already been discussed.

No explanation is available at this time to account for the higher influent BOD results. It is possible the study results were affected by some contaminated dilution water. The more comparable effluent results and the results of later similar tests

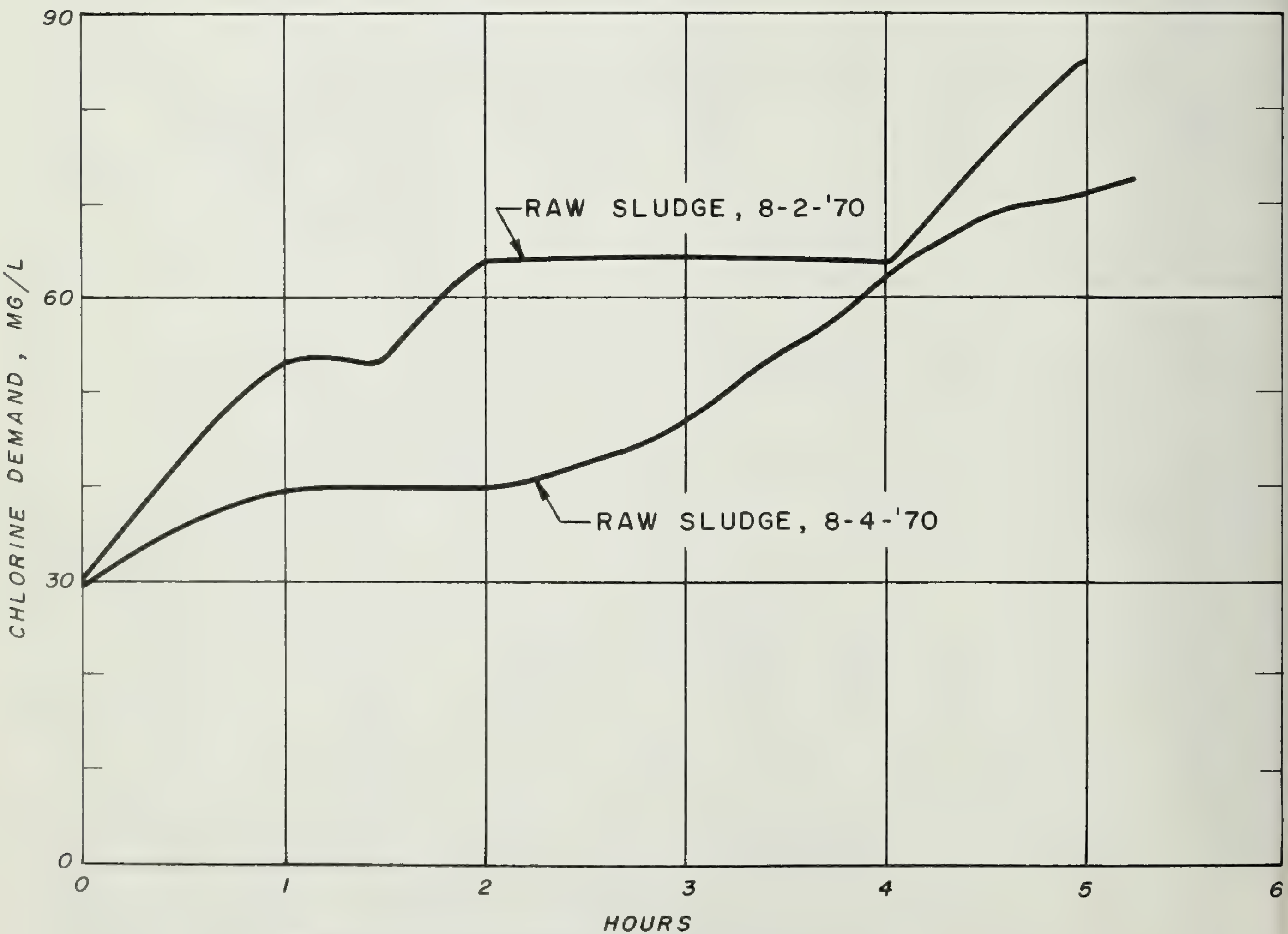

Fig. 3-6 Raw Sludge Chlorine Demand - North Point Plant

Table 3-8 Solids and Nutrients Mass Distribution[a] of Influent, Effluent and Raw Sludge - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day average
	Total suspended solids, 1000 lb/day							
Influent (Mass in)	100	100	72	68	–	110	120	95[b]
Effluent	39	57	–	28	45	54	–	
Raw sludge (T.S. NaCl corrected)	63	57	45	49	78	60	81	
Mass out	102	114	–	77	123	114	–	102[b]
	Volatile suspended solids, 1000 lb/day							
Influent (Mass in)	85	88	59	59	–	–	110	80[b]
Effluent	32	42	33	24	42	–	65	
Raw sludge (NaCl corrected)	45	43	35	36	57	44	61	
Mass out	77	85	68	60	99	–	126	83[b]
	Grease, 1000 lb/day							
Influent (Mass in)	36	34	24	16	31	–	34	29[c]
Effluent	18	21	8	15	20	27	22	
Raw sludge (NaCl corrected)	13	7	4	2	11	11	36	
Mass out	31	28	12	17	31	–	58	30[c]
	COD, 1000 lb/day							
Influent (Mass in)	230	280	210	170	280	260	–	240[c]
Effluent	170	190	150	110	190	150	130	
Raw sludge	87	77	61	59	97	94	99	
Mass out	257	267	211	169	287	244	229	240[c]
	Total nitrogen, 1000 lb/day							
Influent (Mass in)	16	18	15	14	19	16	18	17
Effluent	13	17	13	12	18	14	16	
Raw sludge	2.7	2.7	2.2	2.4	2.8	2.2	2.5	
Mass out	15.7	19.7	15.2	14.4	20.8	16.2	18.5	17
	Total phosphorus,[d] 1000 lb/day							
Influent (Mass in)	14	13	12	12	15	16	13	14
Effluent	13	13	11	11	14	12	13	
Raw sludge	1.4	1.5	1.2	1.1	1.5	1.5	1.9	
Mass out	14.4	14.5	12.2	12.1	15.5	13.5	14.9	14

[a] Mass (influent) = mass (effluent) + mass (raw sludge.

[b] 4-day average.

[c] 6-day average.

[d] Expressed as PO_4.

Table 3-9 Comparison of Study and Plant Analytical Results, Influent - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day average
Total solids, mg/l								
Study	1300	1300	1300	1300	1300	1300	1200	1300
Plant	1330	1385	1550	1430	1335	1385	1240	1380
Suspended solids, mg/l								
Study	190	200	160	160	-	220	230	194[b]
Plant	164	164	136	146	192	178	164	159[b]
Grease, mg/l								
Study	69	65	52	38	60	11	67	54[a]
Plant	-	48	-	41	56	-	-	48[a]
5-day BOD, 20°C, mg/l								
Study	200	190	170	160	210	220	220	200[a]
Plant	-	-	-	210	278	-	299	260[a]
Chlorides (Cl^-), mg/l								
Study	520	470	520	500	610	500	510	520
Plant	498	450	559	543	452	470	402	482
Total alkalinity ($CaCO_3$) mg/l								
Study	120	120	120	110	110	140	150	130[b]
Plant	120	-	120	124	132	132	123	125[b]

[a] 3-day average. [b] 6-day average.

Table 3-10 Comparison of Study and Plant Analytical Results, Effluent - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day average
Total solids, mgl								
Study	1300	1300	1300	1300	-	1200	1200	1300[a]
Plant	1275	1325	1360	1320	1280	1265	1200	1290[a]
Suspended solids, mgl								
Study	77	110	-	66	90	110	-	90[b]
Plant	81	70	73	64	76	75	79	73[b]
Percent removed								
Study	59	45	-	59	-	50	-	53[c]
Plant	51	57	46	56	60	58	52	56[c]
Grease, mg/l								
Study	36	41	19	35	40	54	44	38[d]
Plant	-	32.4	-	28	32.6	-	-	31[d]
5-day BOD, 20°C, mg/l								
Study	170	160	130	120	160	180	170	150[d]
Plant	-	-	-	144	180	-	188	170[d]
Percent removed								
Study	15	16	24	25	24	18	23	24[d]
Plant	-	-	-	31	35	-	37	34[d]
Chlorides (Cl^-), mg/l								
Study	540	520	550	560	850	540	490	580
Plant	510	489	526	545	460	460	421	487
Total alkalinity ($CaCO_3$) mg/l								
Study	110	120	110	110	110	120	130	120[a]
Plant	100	-	115	108	118	113	116	110[a]

[a] 6-day average. [b] 5-day average. [c] 4-day average. [d] 3-day average.

Table 3-11 Comparison of Study and Plant Analytical Results, Raw Sludge - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day average
Total solids, percent								
Study	1.0	0.96	0.84	0.87	1.1	1.0	1.3	1.0
Plant	1.12	1.12	0.78	0.61	0.78	1.03	1.09	1.1
Total volatile solids, percent								
Study	71	75	79	74	74	73	75	74
Plant	71.5	68.0	64.0	58.9	64.9	68.1	70.6	66.5

tend to rule this out.

Except for the differences mentioned above, it is expected that the routine laboratory analyses performed by plant personnel may be utilized in determining the long-range characteristics and yearly variations for the North Point plant.

Plant Performance

Table 3-12 presents a summary of plant removal efficiencies for suspended solids, grease, BOD and COD based on the results obtained during the sampling period. The average removal of suspended solids (54 percent), grease (27 percent) and COD (33 percent) fall within the acceptable range for primary treatment plants. The average BOD removal (22 percent) is below what might be expected for a normal primary treatment plant.

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

The process flows sampled at the Richmond-Sunset plant included influent, effluent, raw sludge to digester, concentration tank decant, digested sludge, digester supernatant, elutriation tank overflow, sludge filter cake and filtrate. With the exception of the filter cake and filtrate, all points were sampled hourly during the entire sampling period and composited on a flow weighted basis into chilled collection vessels. Peak flow grab samples were collected from the influent and effluent and seven-day samples were composited on a flow basis from the daily composited samples of influent, effluent, raw sludge and elutriation tank overflow. Filter cake and filtrate were sampled hourly during periods of filter operation. During the sampling period, construction was underway in the pretreatment section of the plant. As far as could be ascertained, this construction did not affect either the sampling program or plant performance. Some problem did develop in the laboratory determination of the volatile content of all influent and effluent suspended solids. The figures determined have been used in an attempt to determine the significance of the error, however, it should be understood that the existance of the problem does make all Richmond-Sunset study suspended solids determinations suspect.

Loadings - Sewage Treatment

Influent and effluent laboratory data sheets with the complete results of the Richmond-Sunset influent and effluent sampling and analysis program are attached as Appendix C-2 to this report.

Table 3-13 shows those influent and effluent solids loadings that can be meaningfully expressed in total pounds per day. In order to show the magnitude of the recycled loads with respect to the plant influent load, the figures for concentration tanks decant and elutriation tank overflow loads are also given in Table 3-13. The magnitude of these recycled loads in relation to the influent loads indicate that the return flows had little significant influence on plant performance. Fig. 3-7 shows plots of the influent and effluent flows, dissolved oxygen, pH, temperature and settleable solids. Daily total effluent and decant flow figures used in Table 3-13 were provided by the plant staff. The influent flow figures in this table were adjusted to take into account the fact that the influent sample was taken immediately downstream from the point where the raw sludge concentration tanks decant is returned to the plant flow. Elutriation tank overflows, as described later, were measured by the study personnel. Table 3-14 shows nutrients and pesticides loadings while Table 3-15 gives the metal and other trace constituents of the seven-day composite samples. All loads are expressed in pounds per day.

Fig. 3-7 clearly reflects the residential nature of the sewage flows to the Richmond-Sunset plant. The diurnal variations with the pronounced dual daily peaks and the higher Saturday flows are typical for sewage systems serving suburban residential or so-called "bedroom" communities. Average effluent sewage flow for the sampling week at 20.2 mgd was slightly above the enlarged plant design average flow of 20 mgd. The average daily peak of 29.5 mgd and the average daily minimum of 7.4 mgd are what might be expected from a resi-

Table 3-12 Summary of Plant Removal Efficiency - North Point Plant

	Thursday 7/30	Friday 7/31	Saturday 8/1	Sunday 8/2	Monday 8/3	Tuesday 8/4	Wednesday 8/5	7-day average
			Suspended solids, 1000 lb/day					
Influent	100	100	72	68	-	110	120	95[a]
Effluent	39	57	-	28	45	54	-	45[a]
Removed	61	43	-	40	-	56	-	50[a]
Efficiency, percent	61	43	-	59	-	51	-	54[a]
			Grease, 1000 lb/day					
Influent	36	34	24	16	31	5.5	34	26
Effluent	18	21	8	15	20	27	22	19
Removed	18	13	16	1	11	-21.5	12	7
Efficiency, percent	50	38	67	6	35	-400	35	27
			BOD, 1000 lb/day					
Influent	106	98	77	68	107	111	113	97
Effluent	86	83	57	50	80	89	85	76
Removed	20	15	20	18	27	22	28	21
Efficiency, percent	19	15	26	27	25	20	25	22
			COD, 1000 lb/day					
Influent	230	280	210	170	280	260	-	240[b]
Effluent	170	190	150	110	190	150	130	160[b]
Removed	60	70	60	60	90	110	-	80[b]
Efficiency, percent	26	25	29	35	32	42	-	33[b]

[a] 4-day average. [b] 6-day average.

dential area. The fact that the maximum peak of 33 mgd came at 11 am on Saturday substantiates the earlier conclusion that the system serves a residential community reflecting typical suburban life styles and time schedules. Although Sunday's total flow of 19.7 mgd is the lowest of the sampling period, it is not significantly different from the average flow and indicates very little commercial or industrial sewage is tributary to the system. The uniform character of the sewage is also substantiated by the lack of any significant difference between each day's minimum flow either in quantity or hour of arrival.

Richmond-Sunset sewage is not as fresh as Point sewage when it enters the plant. This is evident from the lower dissolved oxygen levels shown on Fig. 3-7. At peak flow on Friday the level was zero. Average dissolved oxygen concentration was above 0.5 mg/l and peak concentrations of over 3 mg/l occurred each day during periods of minimum flow. Although the influent at the Richmond-Sunset plant contains less dissolved oxygen than either of the other two plants, the effluent concentration is substantially higher. The average effluent dissolved oxygen level of approximately 4 mg/l exceeds the level of the other plants and probably reflects both shorter detention periods in plant structures and greater agitation of the effluent at the postchlorination mixer and at the discharge to the Mile Rock sewer.

Influent and effluent pH averaged slightly above 7.0 which is significantly higher than either North Point or Southeast sewage. Effluent temperatures are approximately the same as at the other plants. Effluent settleable solids concentrations parallel flow variations except in the early morning hours of Wednesday and Friday. The high settleable solids in the effluent could have been caused by high elutriation overflows. High elutriation overflows on Sunday night and Tuesday morning did not, however, similarly affect the effluent settleable solids. Maximum settleable solids concentration exceeded the critical level of 1 ml/l/hr at least once a day during the entire sampling period.

In most cases daily plant loadings shown in Table 3-13 are significantly higher on saturday, the day of maximum flow. Total volatile solids, total and volatile suspended solids, and floatable solids are the notable exceptions. It is interesting to note that all of these variables could have been significantly affected by upsets in the concentration tank decant and elutriation tank overflow. None of the nutrient, phenol or chlorinated hydrocarbon pesticides loadings shown in Tables 3-14 follow the plant

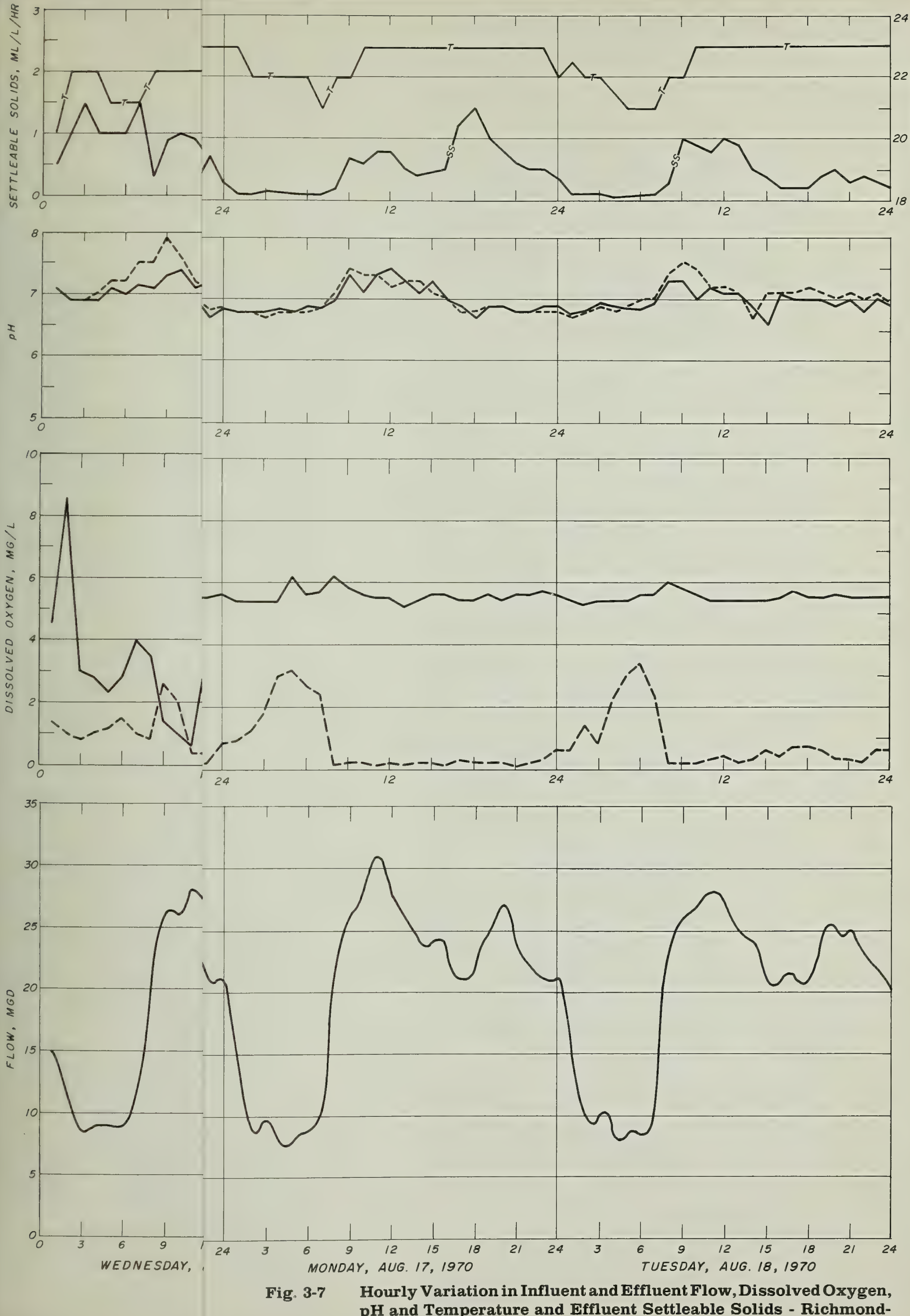

Fig. 3-7 **Hourly Variation in Influent and Effluent Flow, Dissolved Oxygen, pH and Temperature and Effluent Settleable Solids - Richmond-Sunset Plant**

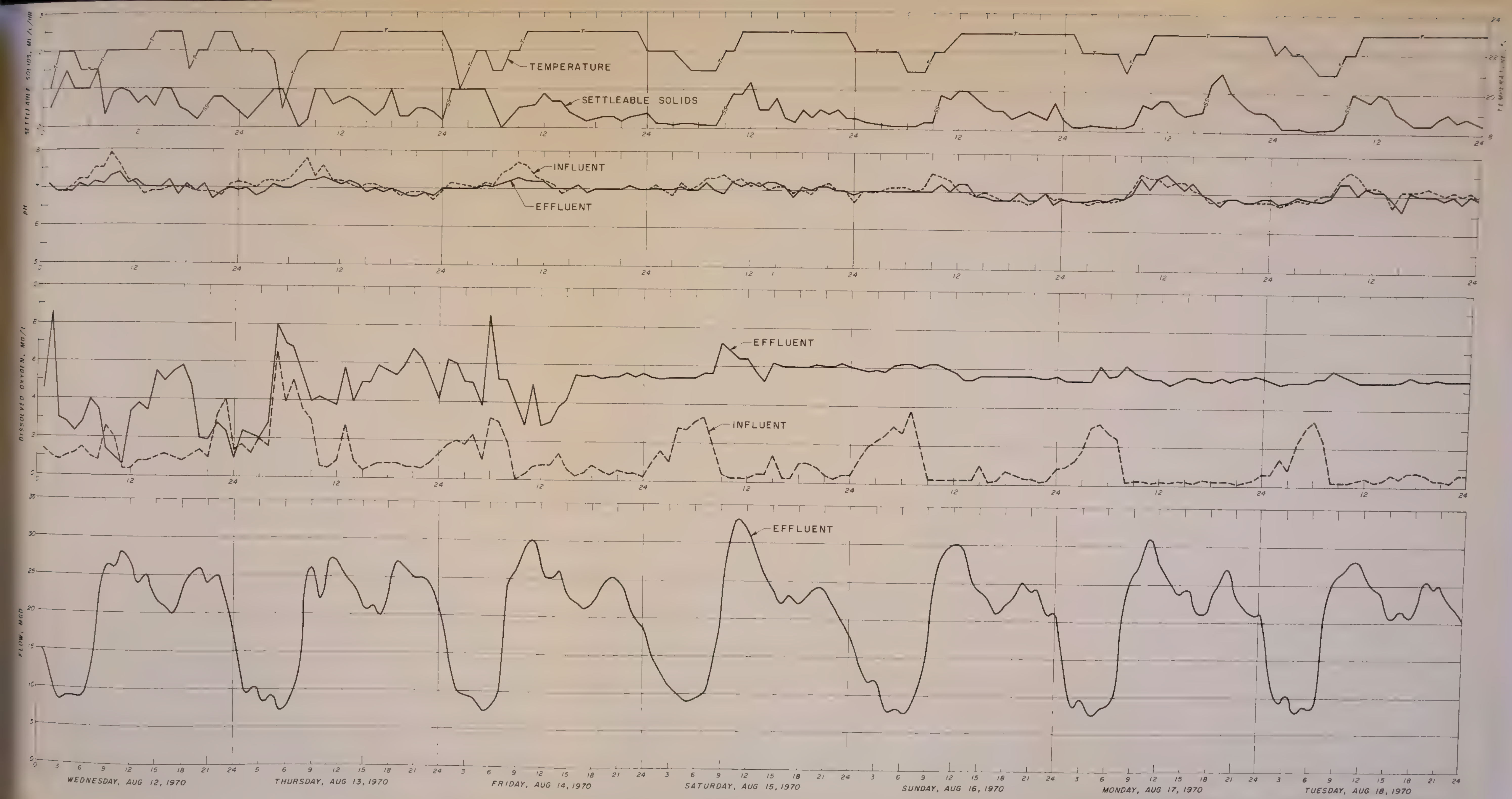

Fig. 3-7 Hourly Variation in Influent and Effluent Flow, Dissolved Oxygen, pH and Temperature and Effluent Settleable Solids - Richmond-Sunset Plant

Table 3-13 Volume and Loadings of Influent[a], Effluent, Raw Sludge Concentration Tank Decant and Elutriation Tank Overflow - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
Flow, mgd								
Influent[b]	20.1	20.3	20.2	20.5	19.7	20.5	20.2	20.2
Effluent	19.7	19.8	19.9	20.1	19.3	20.1	19.8	19.8
Decant[c]	0.20	0.18	0.15	0.20	0.20	0.18	0.17	0.18
Elutriation overflow	0.21	0.27	0.12	0.16	0.18	0.26	0.24	0.21
Total solids, 1,000 lb/day								
Influent	110	100	110	150	110	130	110	120
Effluent	94	86	78	120	98	97	84	93
Decant[c]	2.9	1.0	0.8	1.8	1.7	1.5	1.4	1.6
Elutriation overflow	2.3	2.2	1.2	1.7	1.8	2.6	2.4	2.0
Total volatile solids, 1,000 lb/day								
Influent	62	54	71	70	58	77	74	67
Effluent	51	33	48	52	53	50	51	48
Decant[c]	2.3	0.8	0.6	1.1	1.4	1.2	1.2	1.2
Elutriation overflow	1.6	1.4	0.8	1.0	1.1	1.7	1.8	1.3
Total suspended solids, 1,000 lb/day								
Influent	60	46	56	55	46	46	67	54
Effluent	26	25	17	15	21	-	23	21[e]
Decant[c,d]	-	-	-	-	-	-	-	-
Elutriation overflow	1.6	1.9	0.8	1.5	1.0	1.5	1.6	1.4
Volatile suspended solids, 1,000 lb/day								
Influent[g]	60	46	56	55	46	46	66	54
Effluent[g]	25	25	17	15	21	-	21	21[e]
Decant[c,d]	-	-	-	-	-	-	-	-
Elutriation overflow	1.4	1.8	0.7	1.3	0.9	1.4	1.6	1.3
Floatables, 1,000 lb/day								
Influent	0.70	0.29	0.37	0.51	0.86	0.43	0.45	0.52
Effluent	0.31	0.15	0.47	0.34	0.52	0.50	0.43	0.39
Decant[c,d]	-	-	-	-	-	-	-	-
Elutriation overflow	0.007	0.007	0.004	0.003	0.007	0.013	0.007	0.007
Grease, 1,000 lb/day								
Influent	9.7	8.9	8.9	12	9.8	6.3	10	9.4
Effluent	6.9	7.3	5.2	7.9	9.5	7.4	6.1	7.2
Decant[c]	0.38	0.06	0.11	0.18	0.22	0.21	0.21	0.20
Elutriation overflow	0.13	0.02	0.06	0.16	0.15	0.39	0.20	0.16
5-day BOD, 20°C, 1,000 lb/day								
Influent	27	30	39	39	25	-	22	30[e]
Effluent	26	23	20	16	15	-	13	19[e]
Decant[c,d]	-	-	-	-	-	-	-	-
Elutriation overflow	1.10	0.54	0.22	0.16	0.35	1.40	-	0.63[e]
COD, 1,000 lb/day								
Influent	77	80	88	91	72	79	93	83
Effluent	56	51	55	60	45	54	-	54
Decant[c,d]	-	-	-	-	-	-	-	-
Elutriation overflow	2.5	3.0	1.2	1.3	1.7	2.4	-	2.0[e]

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Table 3-13 (Continued)

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
Chlorides as NaCl, 1,000 lb/day								
Influent	49	34	39	67	44	46	39	45
Effluent	39	35	32	62	34	47	36	41
Decant[c]	0.30	0.30	-	-	-	-	-	0.30[f]
Elutriation overflow	0.55	0.57	0.24	0.34	0.44	0.39	0.43	0.42

[a]Sedimentation tank influent including concentration tank decant and elutriation tank overflow.

[b]Calculated value for flow at point of influent sampling.

[c]Decant is the supernatant liquid from the raw sludge thickening tanks.

[d]Laboratory analysis not made.

[e]6-day average.

[f]2-day average.

[g]Results questionable (see text).

flow variations. These remained fairly constant during weekdays and either dropped significantly or remained unchanged during weekends. Although it might be expected that the pesticide levels would be greater at the Richmond-Sunset plant than at North Point due to more extensive gardens and parks, the actual results show no major variance from those recorded for North Point.

Metallic and other trace elements found in the seven-day composites of influent, effluent, elutriation tank overflow and raw sludge to digester (Table 3-15) were found to be at normal levels for domestic sewage. No unusual concentrations of harmful or toxic wastes were found.

Receiving Waters

Inasmuch as the city is presently considering the construction of a submarine outfall to discharge the plant effluent into the ocean, no separate receiving waters sampling or analysis was done as part of this study. It is expected that the results of an independent study for this outfall will be available for use during the preparation of Phase II of this study.

Loadings - Solids Treatment

Laboratory data sheets with the complete results of the Richmond-Sunset solids sampling and analysis program are attached as part of Appendix C-2 to this report. Table 3-16 shows those solids loadings that can be meaningfully expressed in total pounds per day. Nutrients and metal loadings of the raw sludge and elutriation tank overflow have been included in Tables 3-14 and 3-15, respectively. Fig. 3-8 shows plots of the raw sludge flow divided into its two components, thickened sludge and thickening tank supernatant or decant. The flow values were developed from the logs maintained by the plant operator on duty in the sludge control room. Also shown in the same figure are plots of pH and temperature measurements made by our study team in the field. Raw sludge removal from the sedimentation tanks and its subsequent pumping to digester is a manually controlled operation. As such, it is subject to variations which reflect each operator's individual approach to the task. Patterns reflecting these individual variations are observable in Fig. 3-8. As might be expected, this method does not result in the greatest removal of sludge on the day of the heaviest removal of suspended solids. Actually, the sludge pumping rate varies little from day to day, with an average weekly rate of 100,000 gpd. With all the effort required to operate the raw sludge removal and pumping system, it seems a bit discouraging that the percent solids averages only about 2 percent. The higher pH values for the decant shown on Fig. 3-8 confirm the fact that the material being returned to the sedimentation tank inflow is quite fresh and relatively free of solids. The higher sulfide loading on Saturday seems to confirm the failure of sludge removal on that day to keep up with tank loading. Fig. 3-9 shows plots of the digested sludge and supernatant flows to the elutriation system. Measurements of secondary digester supernatant were made by installing a temporary 90-degree V-notch weir in an inspection box located at the digester control center. Digested sludge flows were computed through readings from a revolution counter installed in the digested sludge positive displacement plunger pump previously calibrated by pumping into a fixed vessel of known size. Also shown in Fig. 3-7 are field measurements of pH and temperature made by the study team. Fig. 3-10 gives the flow variation of the elutriation tank overflow which is returned via the Mile Rock sewer to the treatment plant influent. Elutriation overflow values were obtained by installing temporary blocking sections along the rectangular weir at the outlet end of the east elutriation tank. These sections were

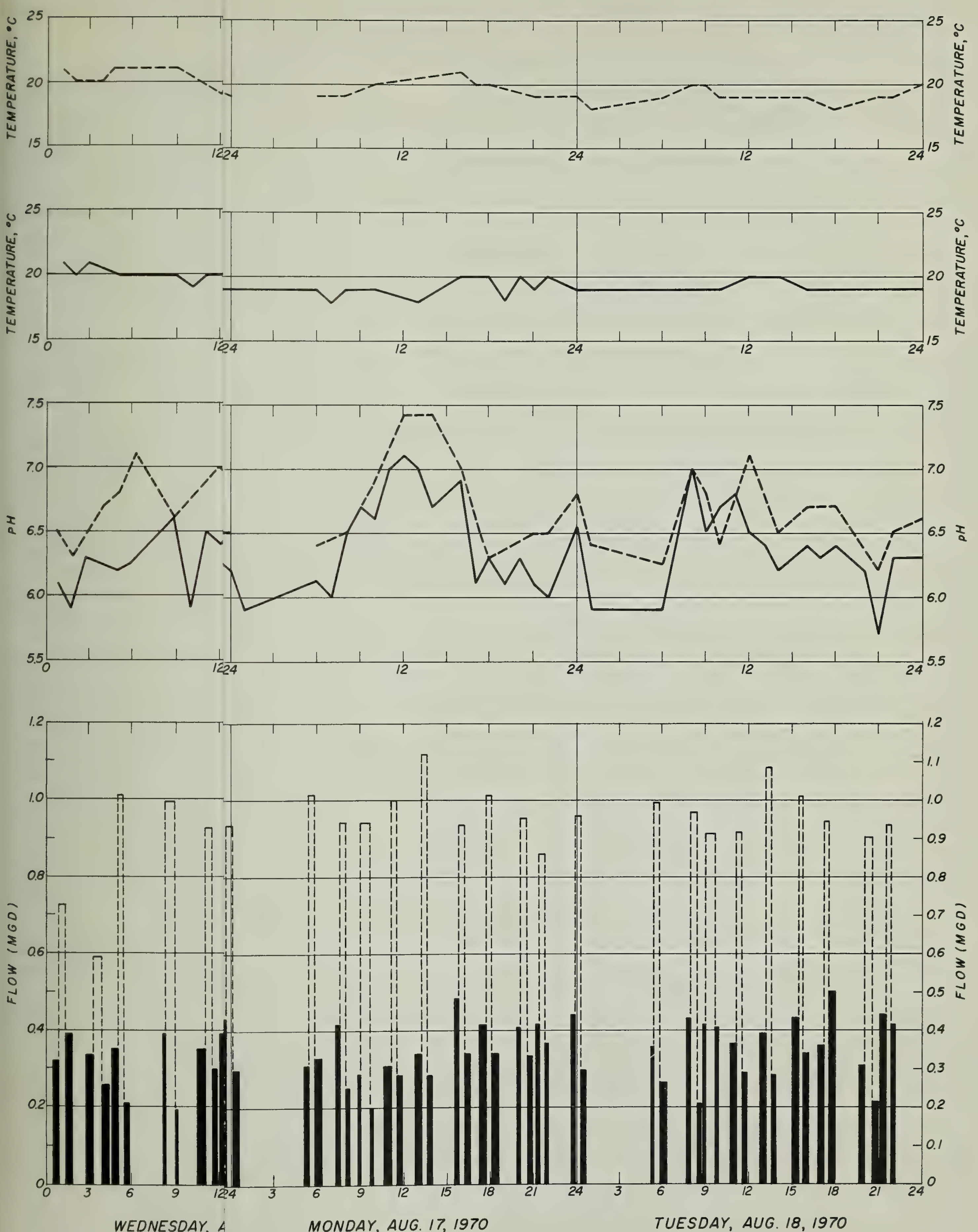

Fig. 3-8 **Hourly Variation in Raw Sludge and Thickening Tank Decant Flow, pH and Temperature - Richmond-Sunset Plant**

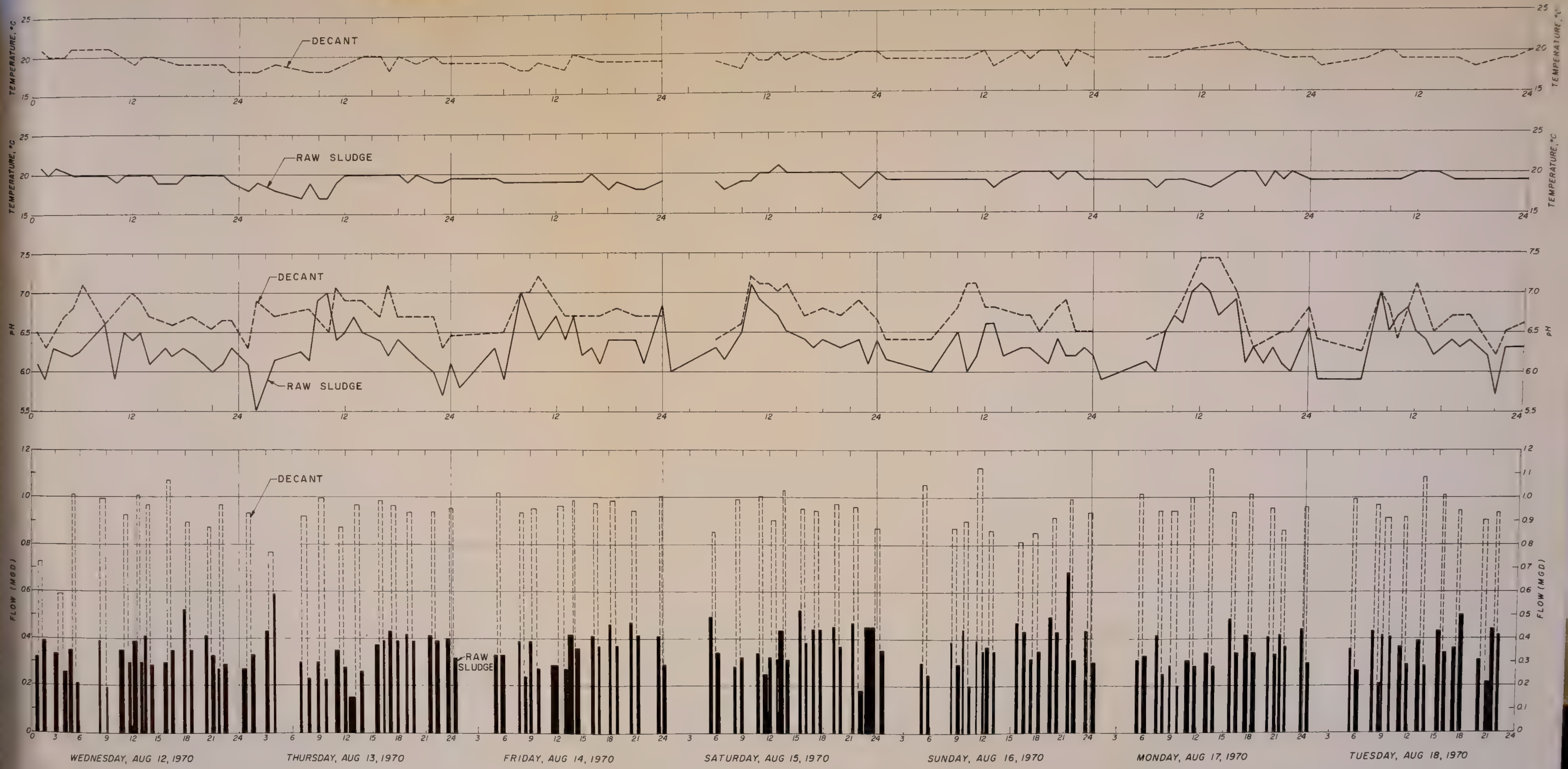

Fig. 3-8 Hourly Variation in Raw Sludge and Thickening Tank Decant Flow, pH and Temperature - Richmond-Sunset Plant

designed to increase the head variations of this weir to measurable amounts. Also plotted are study team field values of pH, temperature and settleable solids. Finally, Fig. 3-11 shows plots of the liquid waste from the vacuum filters, or filtrate, as obtained in a wooden measuring box specially built for this study. Portable clock run, float actuated, drum recorders were utilized for all field measurements. Plots of pH and temperature are also shown in this figure. After the sampling program at the Richmond-Sunset plant was completed, leaks were detected in the vacuum piping which led to the loss of filtrate from the system. Consequently, the flow values presented in Fig. 3-11 are not representative of the total flow of filtrate that is returned to the treatment plant. However, it can be assumed that

Table 3-14 Nutrients and Chlorinated Hydrocarbon Pesticides Loadings of Influent[a], Effluent, Elutriation Tank Overflow and Raw Sludge - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day
Total nitrogen, 1000 lb/day								
Influent	6.0	4.9	6.8	6.5	6.0	6.2	7.4	6.3[b]
Effluent	5.7	4.1	5.6	6.5	6.9	6.7	-	5.9[c]
Elutriation tank overflow	0.38	0.61	0.22	0.32	0.31	0.52	-	0.39[c]
Raw sludge					0.40			
Total phosphorus,[g] 1000 lb/day								
Influent	6.4	5.6	5.9	6.5	6.2	6.2	5.1	6.0[b]
Effluent	6.2	5.8	6.3	6.0	7.2	6.5	-	6.3[b]
Elutriation tank overflow	0.23	0.26	0.09	0.21	0.18	-	-	0.19[c]
Raw sludge					0.31			
Phenols, lb/day								
Influent	32	27	15	14	8	12	12	17[b]
Effluent	28	30	20	8	21	12	15	19[b]
Elutriation tank overflow	0.28	0.34	0.08	0.12	0.12	0.22	0.12	0.18[a]
Lindane, lb/day								
Influent	0.017	0.025	0.025	0.021	0.023	0.021	0.015	0.15[d]
Effluent	0.028	0.021	0.025	0.012	0.043	0.022	0.014	0.17[d]
Heptachlor-epoxide lb/day								
Influent	<0.002	0.012	0.010	<0.002	<0.002	<0.002	<0.002	-
Effluent	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
DDE, lb/day								
Influent	0.030	0.030	0.012	0.002	0.014	0.004	0.008	0.10[d]
Effluent	0.029	0.008	0.010	0.003	0.008	0.025	0.002	0.085[d]
DDD, lb/day								
Influent	0.008	0.019	0.014	0.004	0.008	0.033	0.020	0.11[d]
Effluent	0.008	0.021	0.022	0.008	0.008	0.010	0.008	0.085[d]
DDT, lb/day								
Influent	0.015	0.041	0.040	<0.009	0.021	0.010	0.017	-
Effluent	0.035	0.050	0.025	<0.008	0.018	<0.008	0.010	-
Dieldrin, lb/day								
Influent	0.085	0.035	0.019	0.026	0.041	0.017	0.035	0.26[d]
Effluent	0.065	0.023	0.014	0.015	0.023	0.005	0.023	0.17[d]
TICH, lb/day								
Influent	0.157	0.163	0.120	0.064	0.109	0.087	0.097	0.80[d]
Effluent	0.167	0.125	0.098	0.048	0.102	0.072	0.059	0.67[d]

[a]Sedimentation tank influent including concentration tank decant and elutriation tank overflow.

[b]7-day average.

[c]6-day average.

[d]7-day sum.

[g]Expressed as PO_4.

Table 3-15 Metallic and Other Trace Elements in 7-Day Composite Samples of Influent[a], Effluent, Elutriation Tank Overflow and Raw Sludge - Richmond - Sunset Plant

	Influent		Effluent		Elutriation tank overflow		Raw sludge to digester	
	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day
Iron	1.5	260	0.82	130	8.5	15	68	56
Copper	0.09	16	0.055	9	0.63	1.1	5.1	4.2
Nickel	0.006	1.0	0.003	0.45	0.04	0.07	0.17	0.14
Chromium	0.06	10	0.03	4.5	0.17	0.29	1.0	0.84
Lead	0.005	2.6	0.014	2.2	0.63	1.1	3.4	2.8
Tin	0.03	5.2	0.006	0.9	0.12	0.22	1.0	0.84
Zinc	0.09	16	<0.03	<4.5	1.2	2.2	100	84
Cobalt	<0.003	<0.5	<0.003	<0.5	<0.004	<0.07	0.034	0.03
Silver	0.006	1.0	0.003	0.45	0.04	0.07	0.68	0.56
Vanadium	0.003	<0.5	0.003	<0.5	0.008	0.02	0.068	0.06
Titanium	0.24	41	0.16	27	0.63	1.1	6.8	56
Bismuth	<0.003	<0.5	<0.003	<0.5	0.013	0.02	0.10	0.08
Strontium	0.09	16	0.08	13	0.17	0.29	1.4	1.1
Zirconium	<0.003	<0.5	<0.003	<0.5	0.013	0.02	0.17	0.14
Boron	0.06	10	0.055	9	0.17	0.29	0.34	0.28
Barium	0.6	103	0.03	4.5	2.1	3.6	1.7	14
Cadmium[b]	0.02	3.0	0.03	4.5	-	-	-	-
Aluminum	0.9	160	0.55	90	6.3	11	100	84

[a]Sedimentation tank influent including concentration tank decant and elutriation tank overflow.

[b]Determined by atomic absorption spectrophotometry.

the plot does show the variations of filtrate flow and the graph is only shown for the purpose of illustrating these variations. The flow figures needed to evaluate the filtrate loads given in Table 3-16 were computed from a balance of the flow through the elutriation system and are considered to be an acceptable approximation to the actual flow values.

The flow plots for digested sludge and secondary digester supernatant shown on Fig. 3-9 indicate quite vividly operational problems existing at the time of sampling. Both the primary and secondary digesters are operated at relatively fixed water levels and whenever raw sludge is pumped into the primary digester, secondary digester supernatant must flow to the elutriation system. For several months prior to the sampling period, work on the pretreatment area of the plant allowed a great deal of screenings to pass through the screens and into the solids handling system. During the sampling period, this accumulation of debris periodically clogged the supernatant system, stopped the supernatant flow, and caused a temporary level increase in the primary digester. As soon as the clogged condition was corrected, the supernatant flow increased to its maximum rate until the accumulation of liquid was released. Gradually, as the system returned to normal, the supernatant overflow line again became clogged and the process repeated itself. This condition is reflected in Fig. 3-9 by the gradual decrease in flow over an extended period of time and then the sudden increase in flow as the line was cleared. The shock of such loadings on the elutriation system is clearly shown in Fig. 3-10, where high elutriation tank overflows are almost coincidental with high supernatant flows.

The intermittent operation of the filters also has its effect on the elutriation system. Fig. 3-10 indicates this by showing less direct correlation with the digester sludge and supernatant flows on those days when the filter operated. Even more pronounced effects are noticeable, however, in the mass distribution within the system. These effects are discussed in more detail later in this section. Fig. 3-11 shows the periods of filter operation by recording the periods of filtrate flow. The greater flows at the beginning and end of each period reflect the wash water used to prepare and clean the filters.

Temperature variations indicated in Figs. 3-9 and 3-10 clearly delineate the periods of excessive overflow caused by shock supernatant loadings. The uniform pH values indicate that a relatively stable digestion process is involved. The lower pH of the filtrate results from the chemical additions for filtration. Low settleable solids concentrations in the elutriation overflow indicate that the return of this waste to the plant influent has but little affect on overall plant performance.

Table 3-16 Volume and Loadings of Raw Sludge, Digested Sludge, Sludge Filter Cake and Filtrate - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
Flow, mil gal								
Raw sludge	0.11	0.10	0.10	0.10	0.08	0.09	0.11	0.10
Digested sludge	0.10	0.12	0.17	0.12	0.09	0.15	0.10	0.11
Sludge filter cake, 1000 lbs (wet wt)	51	36	a	a	a	39	32	
Filtrate, 1000 gal	88[b]	110[b]	a	a	a	110[b]	84[b]	
Total solids, 1000 lbs (dry wt)								
Raw sludge	19	15	14	14	12	16	13	15
Digested sludge	7.2	2.1[c]	6.2	4.7	1.4[c]	3.3	2.3	4.7[d]
Sludge filter cake	12	9.4	a	a	a	11	8.3	
Filtrate	0.9	0.6	a	a	a	0.8	1.0	
Total volatile solids, 1000 lbs (dry wt)								
Raw sludge	15	13	12	12	7.0	13	11	12
Digested sludge	4.3	1.3[c]	3.6	2.7	0.9[c]	1.8	1.4	2.8[d]
Sludge filter cake	7.1	5.4	a	a	a	6.2	4.8	
Filtrate	0.6	0.5	a	a	a	0.6	0.6	
Grease, 1000 lbs(dry wt)								
Raw sludge	4.6	4.5	2.1	-	-	2.5	3.4	
Digested sludge	0.48	0.08[c]	1.4	0.38	0.14[c]	0.21	-	
Sludge filter cake	0.50	0.70	a	a	a	0.27	0.92	
Filtrate	0.004	0.002	a	a	a	0.011	0.001	
Chlorides, as NaCl 1000 lbs (dry wt)								
Raw sludge	0.46	0.16	0.41	0.26	0.33	0.39	0.44	
Digested sludge	0.16	0.10	-	0.10	0.15	-	-	
Sulfides, lb/day (dry wt)								
Raw sludge	24	15	15	30	13	17	21	19

[a] Filters not in operation.

[b] Computed from a flow balance of elutriation system.

[c] Sampling line plugged when digested sludge was being pumped to elutriation system.

[d] Thursday and Sunday reading not included (5-day average).

Mass Distribution - Sewage Treatment

A review of the plant flow diagram, Fig. 2-2, indicates that for the Richmond-Sunset plant the sewage treatment process mass distribution is complicated by (1) the recirculation of the concentration tank decant and elutriation tank overflow through the process and (2) the fact that the program's influent sample was taken downstream from the decant discharge ahead of the sedimentation tanks. In addition to the foregoing factors it was necessary to estimate the values for decant suspended solids because it was not anticipated that this determination would be required. Table 3-17 shows the results of mass distribution calculations for plant influent, effluent, elutriation wash water (No. 3W), raw sludge to digester, and decant. The poor correlation obtained for the suspended solids and volatile suspended solids shown in Table 3-17 may in part be attributed to the above factors.

Mass Distribution - Solids Treatment

Any attempted mass distribution of constituents in the solids treatment units must recognize the influence of the large storage capacity available in the digesters and the fact that an appreciable percentage of volatile solids are destroyed during the digestion process. Due to the combined effect of these two factors a mass distribution including the digesters is meaningful only when it encompasses a long operation period.

The sludge elutriation system would seem to lend itself more readily to a short term mass balance. However, intermittent vacuum filter opera-

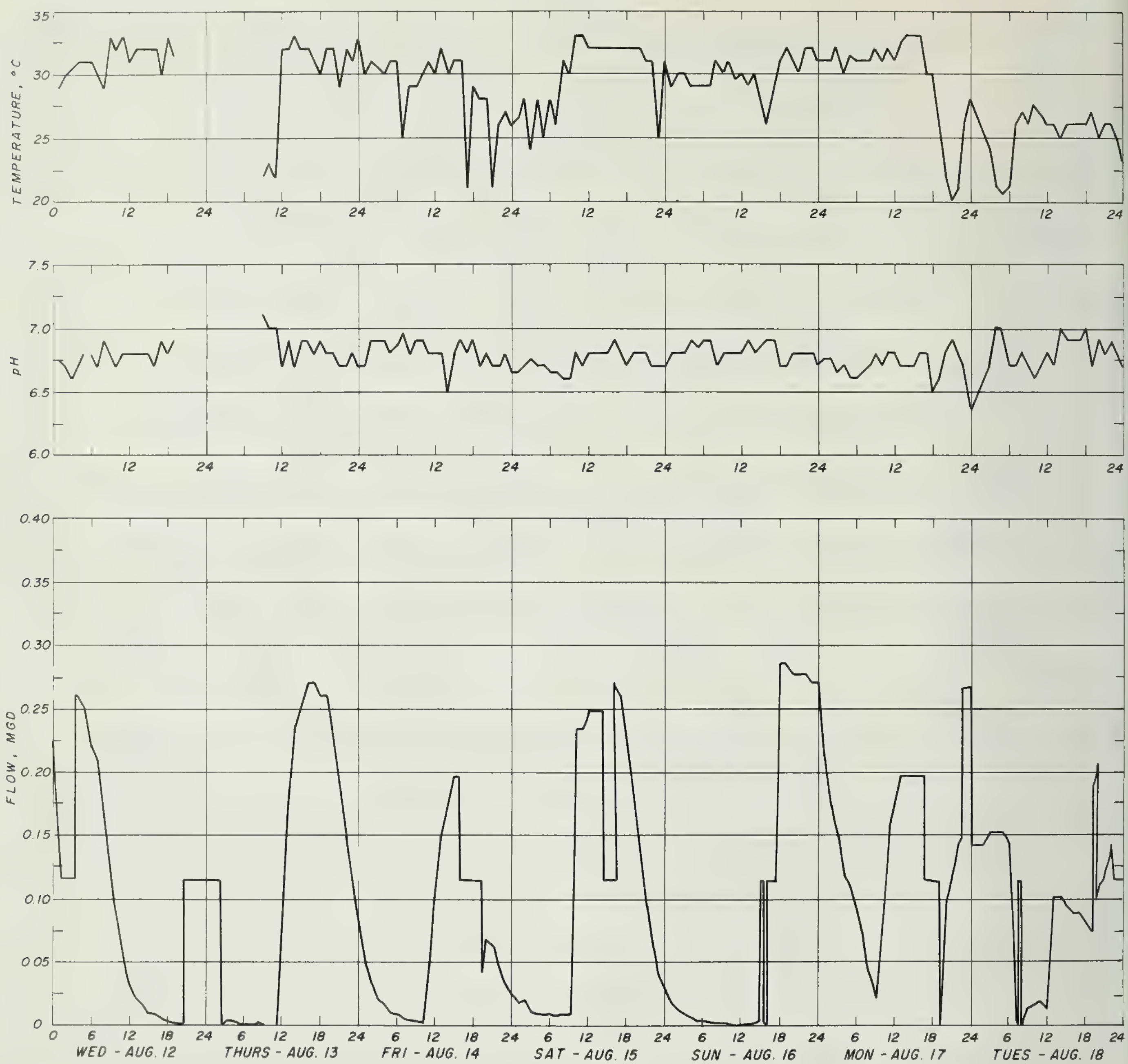

Fig. 3-9 Hourly Variation in Digested Sludge and Supernatant Flow, pH and Temperature - Richmond - Sunset Plant

tion also results in solids storage in this system. Table 3-18 shows the results of mass distribution calculation for suspended and volatile solids in the elutriation system. Figures for filter cake loads were developed from data supplied by the plant staff.

A study of Table 3-18 indicates the effect of intermittent filter operation on this system. Mass flow to the system is variable over the entire week being heavy on Wednesday, Thursday and Friday and tapering off almost entirely on Sunday prior to filter operation commencing again Monday morning. Heavy loadings applied to the system usually don't occur until solids held in the system are depleted as a result of filtering. Loadings applied to the system are regulated by controlling pumping of digested sludge. No regulation of supernatant flow from the digesters is practiced since this is dependent on raw sludge pumping rates. Despite these variables, the overall mass totals of the system, in and out, are relatively equal. If truly representative samples had been available on Thursday and Sunday, it is felt complete correlation would have been possible.

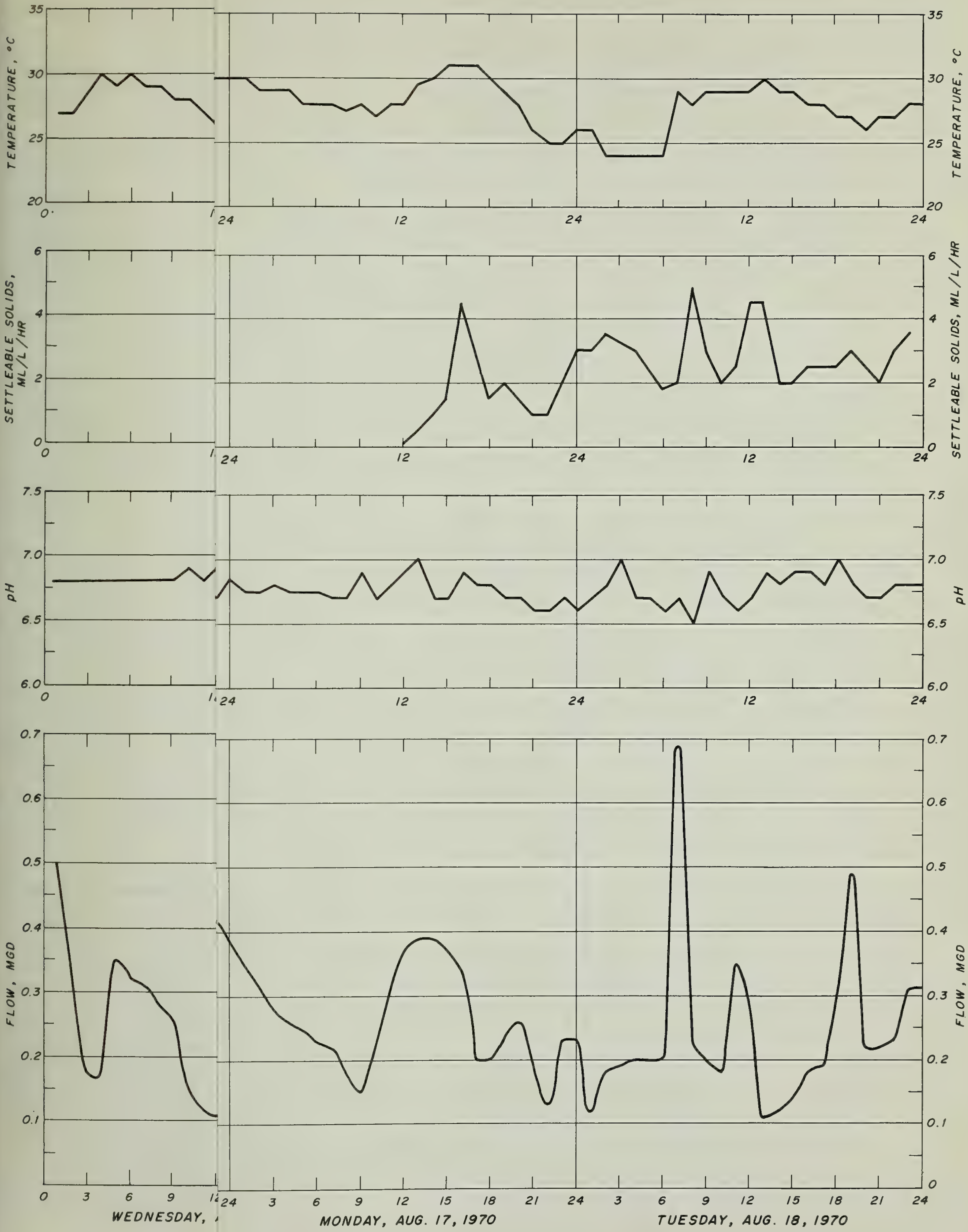

Fig. 3-10 **Hourly Variation in Elutriation Tank Overflow, pH, Temperature and Settleable Solids - Richmond-Sunset Plant**

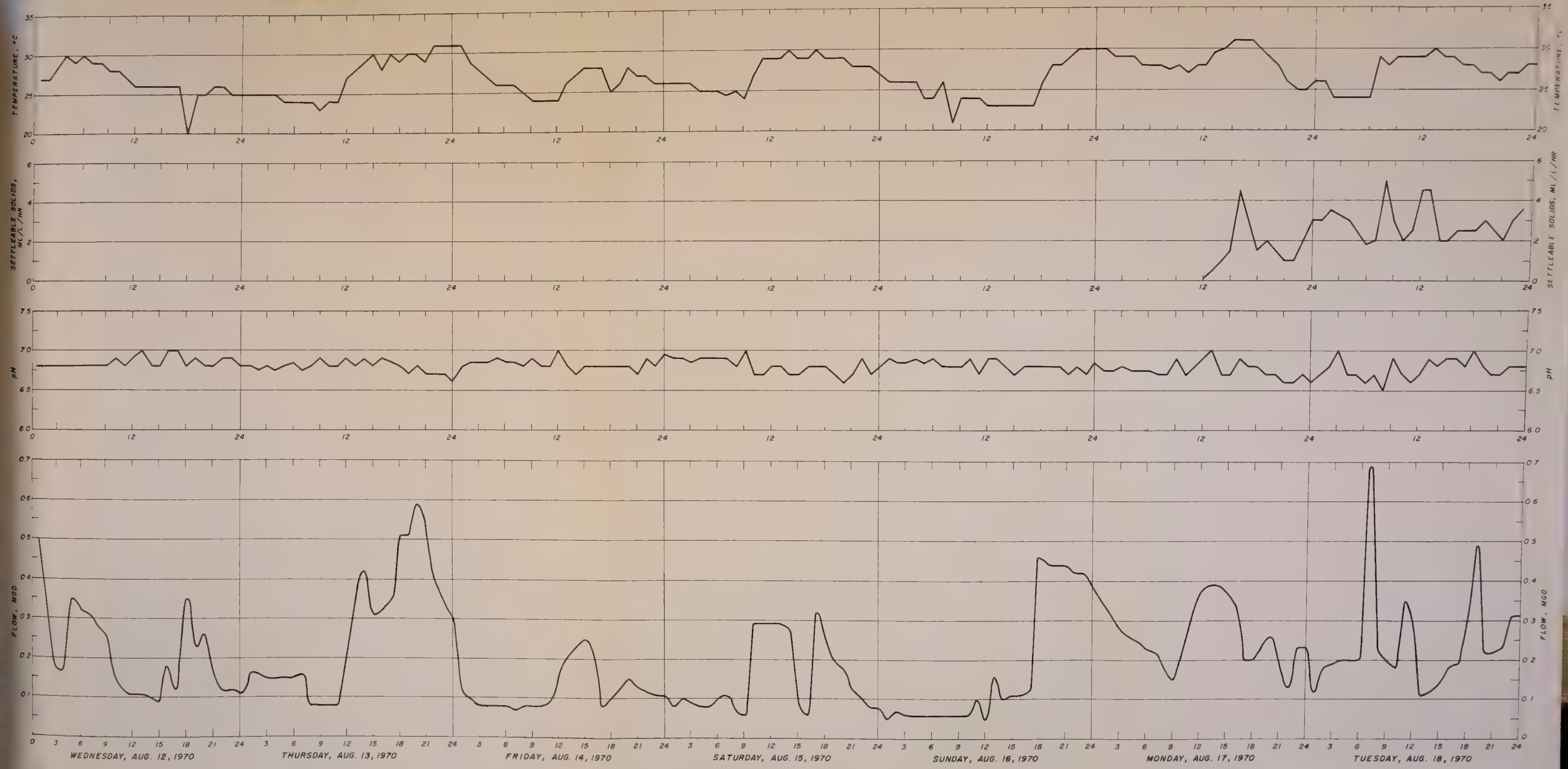

Fig. 3-10 **Hourly Variation in Elutriation Tank Overflow, pH, Temperature and Settleable Solids - Richmond-Sunset Plant**

Table 3-17 Solids Mass Distribution[a] in the Sewage Treatment Process - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
	Suspended solids, 1000 lb/day							
Influent (Mass in)	60	46	56	55	46	46	67	55[e]
Effluent	26	25	17	15	21	-	23	
No. 3 water	0.14	0.14	0.09	0.08	0.11	-	0.12	
Raw sludge to digester[b]	18.5	14.8	13.6	13.7	11.6	15.6	12.6	
Decant[c]	1.8	0.8	0.6	1.1	1.0	0.9	0.8	
Mass out	46	41	31	30	34	-	37	37[e]
	Volatile suspended solids, 1000 lb/day							
Influent (Mass in)[g]	60	46	56	55	46	46	66	55[e]
Effluent	25	25	17	15	21	-	21	
No. 3 water[g]	0.14	0.14	0.09	0.08	0.11	-	0.11	
Raw sludge to digester[b]	14.7	12.8	11.7	11.8	6.8	12.8	10.7	
Decant[d]	1.4	0.5	0.4	0.7	0.8	0.7	0.7	
Mass out	41	38	29	28	29	-	33	33[e]
	Grease, 1000 lb/day							
Influent (Mass in)	9.7	8.9	8.9	12	9.8	6.3	10	8.8[f]
Effluent	6.9	7.3	5.2	7.9	9.5	7.4	6.1	
No. 3 water	.04	.04	.03	.04	.05	.04	.03	
Raw sludge to digester[b]	4.4	4.3	2.0	-	-	2.4	3.2	
Decant	0.38	0.06	0.11	0.18	0.22	0.21	0.21	
Mass out	11.7	11.7	7.3	-	-	10.1	9.5	10[f]

[a] Mass (influent as sampled) = mass (effluent) + mass (No. 3 water) + mass (raw sludge to digester) + mass (decant).

[b] NaCl corrected.

[c] Estimated from total solids.

[d] Estimated from total volatile solids.

[e] 6-day average.

[f] 5-day average.

[g] Results questionable (see text).

Comparisons with Routine Analysis

Tables 3-19, 3-20 and 3-21 tabulate daily composite results over the sampling period for those influent, effluent, raw sludge to digester, and filter cake analysis which coincide with the routine laboratory analysis performed by plant personnel during the sampling period. Review of these comparisons indicates that all except the influent and effluent suspended solids fall within expected sampling and laboratory techniques and tolerance. Both influent and effluent suspended solids results obtained during the study are significantly higher than similar plant measurements although the percent removed is approximately the same. Several reasons for these differences have already been discussed.

Except for the differences mentioned above, it is expected that the routine laboratory analysis performed by plant personnel may be utilized in determining the long-range characteristics and yearly variations for the Richmond-Sunset plant.

Plant Performance

Table 3-22 presents a summary of plant removal efficiencies for suspended solids, grease, BOD and COD based on the results obtained during the sampling period. The average removal of suspended solids (61 percent), grease (24 percent), BOD (37 percent), and COD (33 percent) all fall within the acceptable range for primary treatment plants.

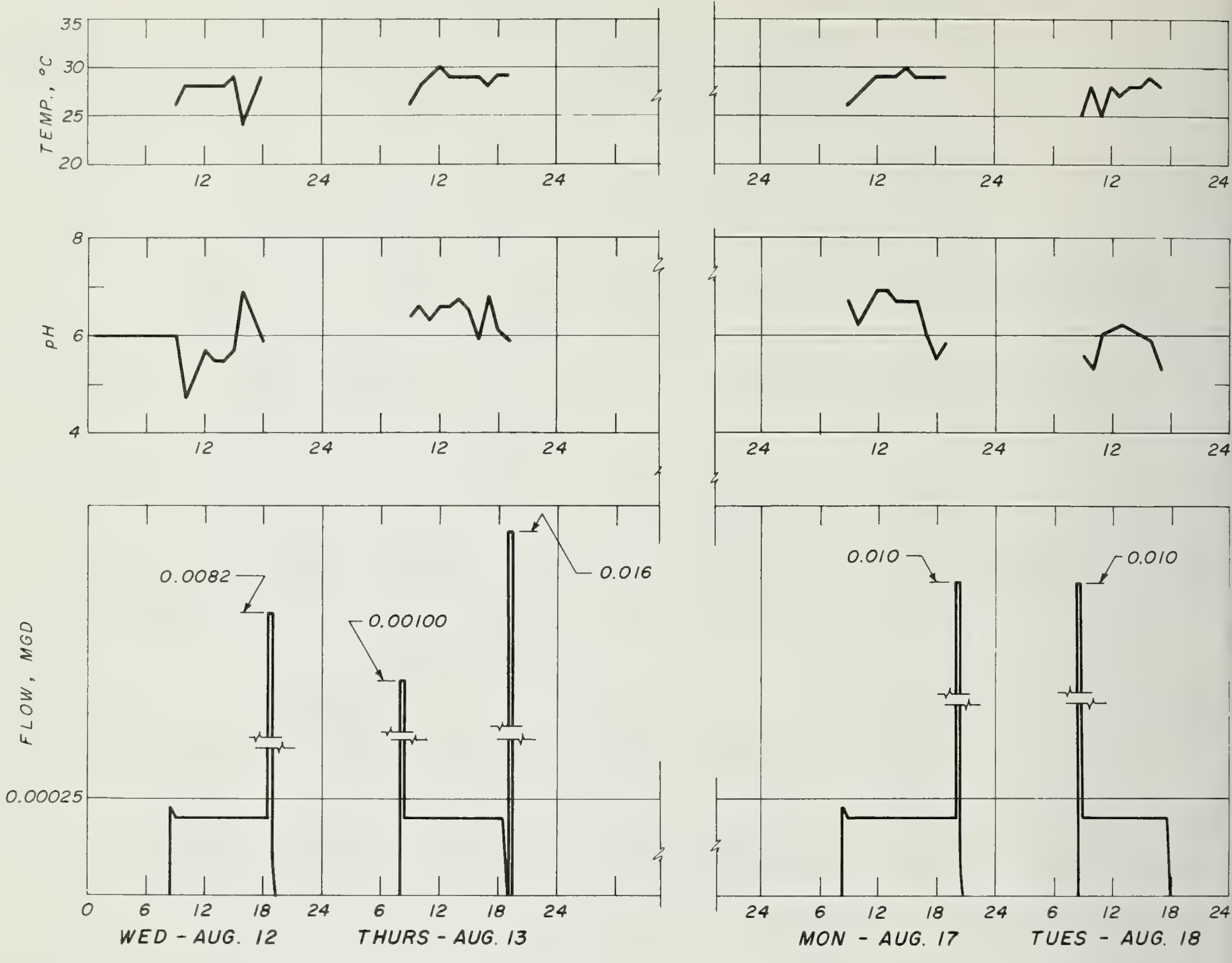

Fig. 3-11 Hourly Variation in Filtrate Flow, pH and Temperature - Richmond - Sunset Plant

SOUTHEAST WATER POLLUTION CONTROL PLANT

The process flows sampled at the Southeast plant included influent, effluent, raw sludge from both the North Point and Southeast plants, thickened sludge to digester, thickening tank overflow, digested sludge, elutriated sludge to filter day tank, elutriation tank overflow, and sludge filter cake. The greater number of sampling points combined with the greater distances at the Southeast plant made it physically impossible for one man to collect, composite and field test every grab sample within a one-hour period. All points, therefore, were sampled every two hours and composited on an adjusted flow basis into chilled collection vessels. None of the results indicates that this longer sampling period had any detrimental effect on any final determinations. Peak flow grab samples were collected from the influent and effluent and seven-day samples were composited on a flow basis from daily composited samples of influent, effluent, North Point raw sludge, Southeast raw sludge, thickened sludge to digesters, elutriated sludge to filter day tank, and thickener and elutriation tank overflows.

Loadings - Sewage Treatment

Influent and effluent laboratory data sheets with the complete results of the Southeast influent and effluent sampling and analysis program are attached as part of Appendix C-3 to this report. Table 3-23 shows those influent and effluent loadings which can be meaningfully expressed in total pounds per day. In order to illustrate the magnitude of the recycled loads with respect to the plant influent load, values for thickening and elutriation tank overflows are also given in Table 3-23. Information contained in this table illustrate the effect of

Table 3-18 Solids Mass Distribution[a] in the Sludge Elutriation System - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day sum
			Suspended solids, 1000 lb/day					
Digested sludge[b]	7.0	2.0[d]	6.1	4.6	1.3[d]	3.2	2.2	
No. 3 water	0.5	0.4	0.3	0.3	0.4	–	0.3	
Chemicals	0.7	0.3	0	0	0	0.5	0.5	
Mass in	8.2	2.7	6.4	4.9	1.7	–	3.0	23[e]
Elutriation tank overflow	1.6	1.9	0.8	1.5	1.0	1.5	1.6	
Filter cake	12	9.4	0	0	0	11	8.3	
Filtrate[c]	0.9	0.6	0	0	0	0.8	1.0	
Mass out	14.5	11.9	0.8	1.5	1.0	13.3	10.9	28[e]
			Volatile suspended solids, 1000 lb/day					
Digested sludge[b]	4.2	1.3[d]	3.5	2.7	0.8[d]	1.8	1.4	
No. 3 water	0.3	0.2	0.2	0.3	0.3	–	0.3	
Chemicals	0.5	0.2	0	0	0	0.3	0.3	
Mass in	5.0	1.7	3.7	3.0	1.1	–	2.0	14[e]
Elutriation tank overflow	1.4	1.8	0.7	1.3	0.9	1.4	1.6	
Filter cake	7.1	5.4	0	0	0	6.2	4.8	
Filtrate[c]	0.6	0.5	0	0	0	0.6	0.6	
Mass out	9.1	7.7	0.7	1.3	0.9	8.2	6.0	17[e]

[a]Mass (digested sludge) + mass (No. 3 water) + mass (added chemicals) = mass (elutriation tank overflow) + mass (filter cake) + mass (filtrate).

[b]NaCl corrected.

[c]Estimated from total solids.

[d]Sampling line plugged when digested sludge was being pumped to elutriation system.

[e]4-day sum (Wednesday, Friday, Saturday and Tuesday).

of the returned flows on this treatment plant. Although hydraulically insignificant, the combined suspended solids loading of the thickening and elutriation tank overflows exceeds the suspended solids loading of the influent by a maximum of 90 percent, an average of over 30 percent and a minimum of 10 percent. Fig. 3-12 shows plots of the influent and effluent flow, dissolved oxygen, pH, temperature and settleable solids measurement made in the field by the sampling personnel. Effluent flow includes all of the North Point sludge flow which accounts for the difference between the two flows. Daily total flow figures used in Table 3-23 were provided by the plant staff. Table 3-24 were provided by the plant staff. Table 3-24 shows nutrients and pesticides loadings while Table 3-25 gives the metal contents of the seven-day composite samples. All loads are expressed in pounds per day.

Fig. 3-12 indicates that the Southeast plant is the only plant to receive significant quantities of sewage on a cyclic basis. This usually reflects the on and off operation of some major pumping station tributary to the system. The fact that the cycles continue around the clock pretty well confirms this conclusion. Disregarding the cyclic fluctuations, diurnal variations are quite similar to those of the North Point plant. Also, as with the North Point plant, weekend flows are lower than weekday flows as indicated in Table 3-23. Average effluent sewage flow for the sampling period of 19.2 mgd was well below the design average flow of 30 mgd. The average daily peak of 30.0 mgd and the average daily minimum of 10.6 mgd are normal variations. The maximum peak flow of 31.5 mgd came at 12 noon on Thursday, exactly the same time and day of the week when the maximum peak flow was recorded for the North Point plant. The peak influent flow of 35.5 mgd on Monday resulted from a short term closure of the influent gate and is therefore not considered a normal condition. These flow characteristics are typical of the commercial-industrial area tributary to Southeast plant. Loadings, as shown in Table 3-23, indicate the more industrial character of the tributary area as compared to the tributary areas of the North Point and Richmond-Sunset plants. The industrial nature of the tributary

Table 3-19 Comparison of Study and Plant Analytical Results, Influent[a] - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
Total solids, mg/l								
Study	680	600	670	870	690	730	670	700
Plant	550	540	532	782	702	624	549	610
Suspended solids, mg/l								
Study	360	270	330	320	280	270	400	320
Plant	137	152	184	154	142	157	154	155
Grease, mg/l								
Study	58	53	53	71	60	37	60	55[c]
Plant	48	-	48	52	-	48	-	49[c]
5-day BOD, 20°C, mg/l								
Study	160	180	230	230	150	-	130	207[d]
Plant	187	-	194	173	-	-	-	185[d]
Chlorides (Cl^-), mg/l								
Study[b]	180	120	140	240	170	160	140	170[e]
Plant	148	107	-	231	186	145	-	164[e]
Alkalinity ($CaCO_3$) mg/l								
Study	140	150	140	140	130	150	130	140[e]
Plant	156	150	-	152	150	156	-	153[e]

[a] B&C, sedimentation tank influent including concentration tank decant and elutriation tank overflow. Plant, sedimentation tank influent including only elutriation tank overflow.

[b] Reported as NaCl in laboratory analysis sheet.

[c] 4-day average. [d] 3-day average. [e] 5-day average.

area also helps to explain the Sunday maximum peak flow of 26.0 mgd and minimum flow of 9.5 mgd, the lowest of any day during the sampling period.

Sewage entering the Southeast plant is fresh. Except for a few minor deviations, the dissolved oxygen in the influent is usually above 2 mg/l. Effluent dissolved oxygen is approximately the same as that in the influent. Influent and effluent pH are lower than at North Point which probably reflects the effect of industrial wastes. Temperatures are also somewhat lower than at North Point. Settleable solids concentrations in the effluent exceeded the critical level of 1 mg/l for the first three days of the sampling period and then remained below that level for the rest of the time. No logical explanation is readily apparent for this occurrence.

The greater strength of the sewage at the Southeast plant when compared to the other two plants is evident from a comparison of the loading at the three plants. For instance, although the flow to the Southeast plant is only approximately one-third of the flow to North Point, the loadings at the Southeast plant as shown in Tables 3-23, 3-24 and 3-25, almost equal or exceed the loadings at North Point plant as shown in Tables 3-4, 3-5 and 3-6. This is especially true of the phenols where Southeast sewage is over ten times as concentrated as North Point sewage and chromium where Southeast sewage is almost seven times as concentrated as North Point sewage. Both these higher concentrations reflect the presence of industrial wastes like plating and tannery wastes. Pesticide loadings at the Southeast plant are somewhat higher than at the other two plants, but they are still not considered significant.

Receiving Waters

A parallel receiving waters sampling and analysis program was performed as part of the study of the Southeast plant. The program has not been completed, however, due to a rupture in an effluent line from the plant. The findings of the study of the receiving waters will be the subject of a supplemental report to be submitted at a later date.

Loadings - Solids Treatment

Laboratory data sheets with the complete results of the Southeast solids sampling analysis program are attached as part of Appendix C-3 to this report. Table 3-26 shows those solid loadings which can be meaningfully expressed in total pounds per day while Tables 3-24 and 3-25 show the results of the nutrient and metal determinations of weekly composites of solid samples. Fig. 3-13 shows plots

Table 3-20 Comparison of Study and Plant Analytical Results, Effluent - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
Total solids, mg/l								
Study	570	520	470	700	610	580	510	570
Plant	488	462	428	706	618	540	451	530
Suspended solids, mg/l								
Study	160	150	100	90	130	–	140	130[b]
Plant	37	65	71	54	56	63	52	56[b]
Percent removed								
Study	56	44	70	72	54	–	65	59[b]
Plant	73	57	61	65	60	60	66	64[b]
Grease, mg/l								
Study	42	44	31	47	59	44	37	41[c]
Plant	37	–	36	38	–	40	–	38[c]
5-day BOD, 20°C mg/l								
Study	160	140	120	98	90	–	79	126[d]
Plant	134	–	139	132	–	–	–	135[d]
Percent removed								
Study	0	22	48	57	40	–	39	35[d]
Plant	28	–	28	24	–	–	–	27[d]
Chlorides, as Cl mg/l								
Study[a]	150	130	120	230	130	170	130	160[e]
Plant	154	124	–	230	192	152	–	170[e]
Alkalinity, mg/l								
Study	133	140	137	140	132	142	125	140[e]
Plant	128	128	–	126	124	130	–	127[e]

[a] Reported as NaCl in laboratory analysis sheets.
[b] 6-day average. [d] 3-day average.
[c] 4-day average. [e] 5-day average.

Table 3-21 Comparison of Study and Plant Analytical Results, Raw Sludge and Sludge Filter Cake - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
				Raw sludge				
Total solids, percent								
Study	2.0	1.8	1.7	1.6	1.8	2.0	1.5	1.8
Plant	2.24	2.82	1.64	2.08	2.17	2.12	2.17	2.18
Total volatile solids, percent								
Study	83	86	82	83	61	85	86	81
Plant	83.3	89.2	83.0	86.5	85.5	83.4	86.5	85.0
				Filter cake				
Total solids, percent								
Study	24	26				28	26	26[a]
Plant	25.2	23.3				25.5	26.6	25.2[a]

[a] 4-day average.

Table 3-22 Summary of Plant Removal Efficiency - Richmond - Sunset Plant

	Wednesday 8/12	Thursday 8/13	Friday 8/14	Saturday 8/15	Sunday 8/16	Monday 8/17	Tuesday 8/18	7-day average
			Suspended solids, 1000 lb/day					
Influent[a]	60	46	56	55	46	46	67	54[b]
Effluent	26	25	17	15	21	-	23	21[b]
Removed	34	21	39	40	25	-	44	33[b]
Efficiency percent	57	46	70	73	54	-	66	61[b]
			Grease, 1000 lb/day					
Influent[a]	9.7	8.9	8.9	12	9.8	6.3	10	9.4
Effluent	6.9	7.3	5.2	7.9	9.5	7.4	6.1	7.2
Removed	2.8	1.6	3.7	4.1	0.3	- 1.1	3.9	2.2
Efficiency	29	18	42	34	3	- 17	39	24
			BOD, 1000 lb/day					
Influent[a]	27	30	39	39	25	-	22	30[b]
Effluent	26	23	20	16	15	-	13	19[b]
Removed	1	7	19	13	10	-	9	11[b]
Efficiency	4	23	49	33	40	-	41	37[b]
			COD, 1000 lb/day					
Influent[a]	77	80	88	91	72	79	93	81[b]
Effluent	56	51	55	60	45	54	-	54[b]
Removed	21	29	33	31	27	25	-	27[b]
Efficiency	27	36	38	34	38	32	-	33[b]

[a] Sedimentation tank influent including concentration tank decant and elutriation tank overflow.

[b] 6-day average.

of the raw sludge flows from the North Point and Southeast plants along with pH and temperature measurements made in the field by the sampling personnel. Raw sludge flows were developed from plant records. Fig. 3-14 shows a plot of the east thickening tank overflow and the corresponding measurements of pH and temperature. To obtain this overflow measurement, it was necessary to construct new rectangular overflow weirs of uniform edge and limited length. These new weirs were designed to increase the head variations above the weirs to measureable amounts. The succes of this venture is attested to by the excellent correlation between incoming raw sludge flows and thickening tank overflow. Study of Figs 3-13 and 3-14 shows the variation in tank overflow resulting from variations in either the North Point or Southeast raw sludge flows.

Both raw sludges have amazingly high and uniform pH and temperature measurements. One would expect the older sludge age in these systems to lower both the pH and temperature significantly. As indicated by Fig. 3-13, one Southeast sludge pump was operated practically continuously during the entire sampling period while the raw sludge force main from the North Point plant was flushed twice. Peak flow of North Point sludge during these flushing intervals slightly exceeded 1.4 mgd. Peak flow of Southeast sludge was about 0.5 mgd and took place Wednesday evening. Review of the flow curves indicate the simultaneous operation of both raw sludge pumps at this time.

Superimposing the raw sludge flow curves (Fig. 3-13) over the sludge thickening tank overflow curves (Fig. 3-14) provides a means of estimating the rate of sludge feed to the digester. It was not possible to measure this flow directly, but from the difference in the two curves the periods of thickened sludge pumping became obvious and a reasonably close estimate of the rate of sludge feed to the digesters could be made. Flow values obtained in this manner were used in computing the thickened sludge loads shown in Table 3-26.

Fig. 3-15 gives a plot of the combined overflow from the elutriation tanks. These flow figures were obtained in wooden measuring boxes provided with a 90 degree V-notch weir, specially built for this study. One box with level measuring meter was pro-

Table 3-23 Volume and Loadings of Influent, Effluent, Thickening Tank Overflow and Elutriation Tank Overflow - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-day average
Flow, mgd								
Influent	20.0	19.8	19.9	18.1	16.8	19.7	20.1	19.2
Effluent	20.9	20.7	20.8	19.0	17.7	20.7	21.0	20.1
Thickening tank overflow	0.93	0.86	0.89	0.77	0.72	0.81	0.81	0.82
Elutriation tank overflow	1.4	1.2	1.3	1.5	1.5	1.4	1.5	1.4
Total solids, 1000 lb/day								
Influent	720	660	580	530	520	530	550	580
Effluent	570	550	590	590	560	590	580	570
Thickening tank overflow	160	79	68	60	36	68	-	78[a]
Elutriation tank overflow	58	63	71	82	83	87	200	92
Total volatile solids, 1000 lb/day								
Influent	250	480	470	180	180	230	340	300
Effluent	240	330	450	140	220	260	250	270
Thickening tank overflow	120	58	44	41	27	53	-	57[a]
Elutriation tank overflow	29	43	46	55	50	57	140	60
Suspended solids, 1000 lb/day								
Influent	77	78	83	59	42	59	82	69
Effluent	63	36	47	41	35	48	60	47
Thickening tank overflow	85	57	51	44	20	56	-	59[a]
Elutriation tank overflow	21	37	40	44	48	56	15	31
Volatile suspended solids, 1000 lb/day								
Influent	67	63	73	53	31	48	65	57
Effluent	52	26	36	29	25	35	49	36
Thickening tank overflow	64	42	38	33	15	42	-	39[a]
Elutriation tank overflow	15	23	25	29	33	35	9	24
Floatables, 1000 lb/day								
Influent	0.32	0.56	1.30	0.35	0.30	0.40	0.54	0.54
Effluent	0.21	0.26	0.42	0.67	0.28	0.40	0.26	0.36
Thickening tank overflow	0.026	0.17	0.17	0.076	0.030	0.10	0.036	0.043
Elutriation overflow	0.056	0.040	0.037	-	0.079	0.067	0.013	0.049[a]
Grease, 1000 lb/day								
Influent	14	19	23	7.3	9.5	16	23	16
Effluent	11	12	13	4.4	9.7	11	14	11
Thickening tank overflow	7.0	7.9	33	4.5	3.6	7.4	-	10[a]
Elutriation tank overflow	2.9	12	6.7	4.8	13	11	2.3	7.5
BOD, 1000 lb/day								
Influent	60	50	50	26	18	53	55	45
Effluent	37	26	35	24	21	28	53	32
Thickening tank overflow	19	21	36	10	35	20	37	25
Elutriation tank overflow	9.1	11	13	16	16	18	7.0	13
COD, 1000 lb/day								
Influent	150	150	150	120	67	130	140	130
Effluent	130	110	120	86	68	87	110	100
Thickening tank overflow	200	140	130	77	52	68	130	110
Elutriation tank overflow	110	92	86	58	59	18	20	63
Chlorides as NaCl			No results					

[a]6-day average.

Table 3-24 Nutrients and Chlorinated Hydrocarbon Pesticides Loadings of Influent, Effluent, Raw Sludge from North Point Plant, Raw Sludge from Southeast Plant, Thickening Tank Overflow, Elutriation Tank Overflow and Thickened Sludge - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-Day
Total nitrogen, 1000 lb/day								
Influent	6.9	7.2	9.3	7.1	6.6	10.0	-	7.9[a]
Effluent	8.6	8.0	9.5	9.2	7.3	11.0	-	8.9[a]
Thickening tank overflow	4.3	3.9	3.9	2.6	1.8	1.7	1.5	2.8[b]
Elutriation tank overflow	4.0	-	-	-	-	-	-	-
North Point raw sludge					1.8		7.6	
Southeast raw sludge					3.1		3.1	
Thickened sludge to digester					5.5		5.5	
Total phosphorus,[e] 1000 lb/day								
Influent	4.0	5.0	6.6	6.5	3.1	5.2	-	5.0[a]
Effluent	3.7	3.8	6.2	5.9	3.2	4.8	16.0	6.2[b]
Thickening tank overflow	4.8	-	-	1.1	1.4	2.4	5.8	3.1[c]
Elutriation tank overflow	3.6	3.5	-	-	3.0	2.3	-	3.1[d]
North Point raw sludge					0.29		-	
Southeast raw sludge					3.3		-	
Thickened sludge to digester					4.4		-	
Phenols, lb/day								
Influent	22	30	30	11	5.6	20	32	21[b]
Effluent	26	17	26	27	19	14	30	22[b]
Thickening tank overflow	1.6	3.3	1.0	0.6	0.7	0.5	0.3	1.1[b]
Elutriation tank overflow	9.1	5.4	0.9	0.8	1.4	0.8	0.8	2.7[b]
Lindane, lb/day								
Influent	0.022	-	0.014	0.009	0.020	0.028	0.014	0.11[e]
Effluent	0.019	0.014	0.012	0.008	0.016	0.009	0.009	0.073[e]
Heptachor-epoxide, lb/day								
Influent	<0.002	-	<0.002	<0.002	<0.001	<0.002	<0.002	-
Effluent	<0.002	<0.002	<0.002	<0.002	<0.001	<0.002	<0.002	-
DDE, lb/day								
Influent	0.045	0.073	0.020	0.009	0.008	0.003	0.008	0.17[f]
Effluent	0.065	0.036	0.024	0.016	0.006	0.012	0.004	0.16[f]
DDD, lb/day								
Influent	0.023	0.026	0.007	0.017	0.022	0.010	0.022	0.13[f]
Effluent	0.021	0.024	0.019	0.025	0.025	0.010	0.005	0.13[f]
DDT, lb/day								
Influent	0.023	0.012	0.041	0.033	0.029	0.016	0.014	0.17[f]
Effluent	0.023	0.022	0.028	0.040	0.027	<0.009	0.018	-
Dieldrin, lb/day								
Influent	0.015	0.025	0.014	0.029	0.027	0.005	0.017	0.13[f]
Effluent	0.012	0.021	0.017	0.017	0.012	0.003	0.009	0.091[f]

[a] 6-day average. [d] 4-day average. [e] Expressed as PO_4.
[b] 7-day average. [e] 6-day sum.
[c] 5-day average. [f] 7-day sum.

vided for each pair of tanks. Also shown are plots of field measurements of pH and temperature. Fig. 3-15 also gives plots of pH and temperature of the digested sludge flow into the elutriation tanks. The physical layout of the elutriation tank mixing boxes made it impossible to measure the digested sludge feed to the elutriation system. Consequently, flow values for digested sludge were calculated

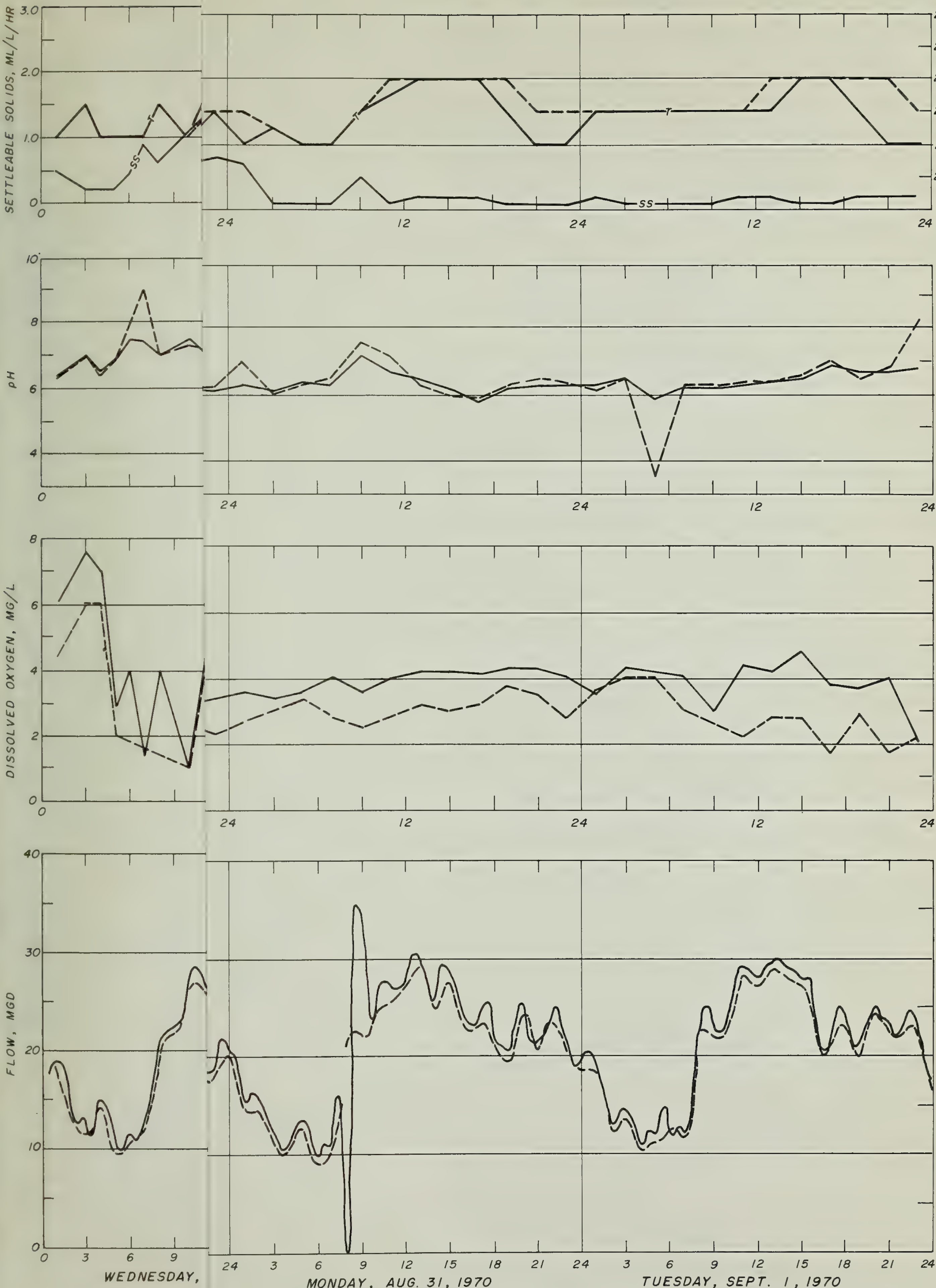

Fig. 3-12 **Hourly Variation in Influent and Effluent Flow, Dissolved Oxygen, pH and Temperature and Effluent Settleable Solids - Southeast Plant**

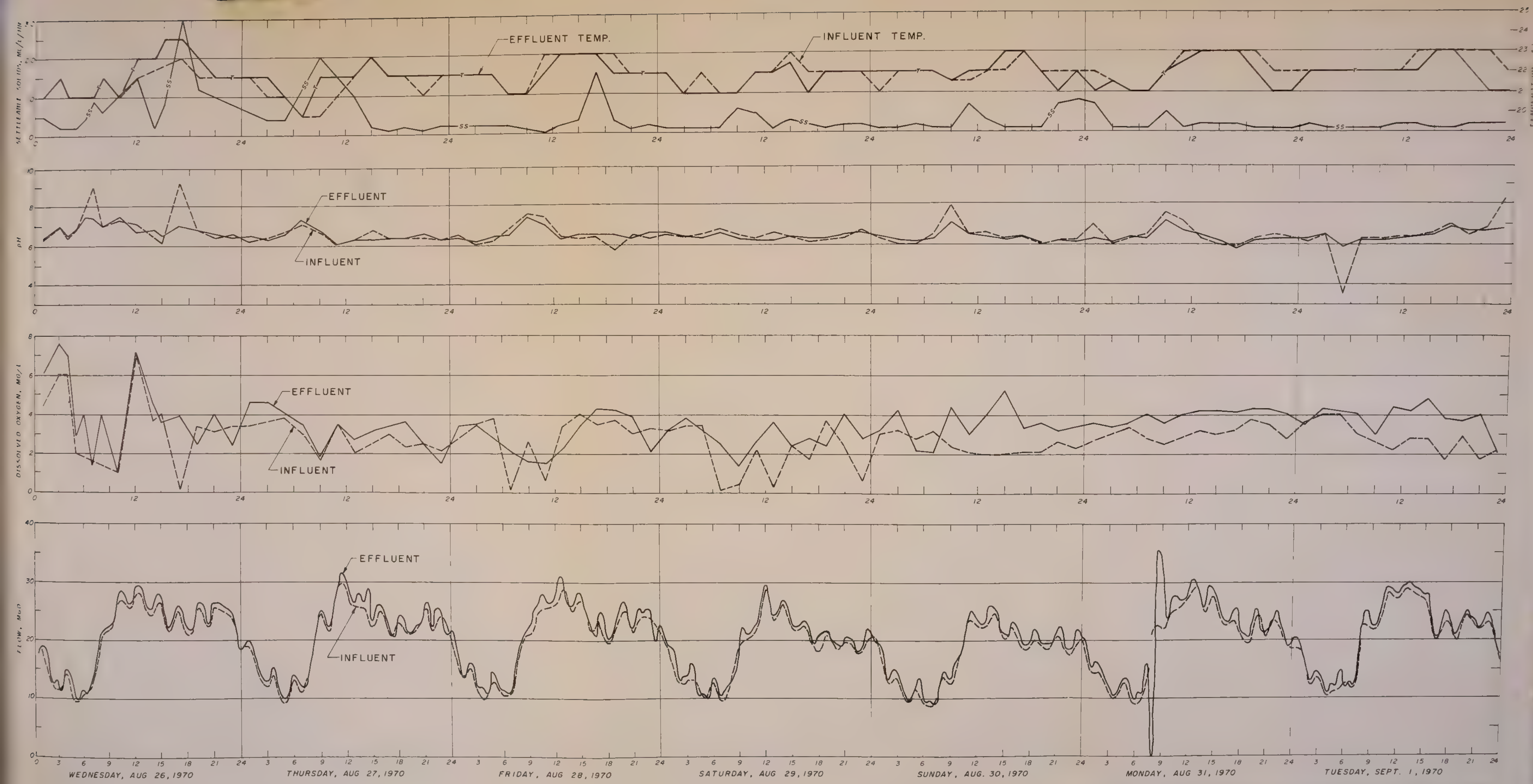

Fig. 3-12 **Hourly Variation in Influent and Effluent Flow, Dissolved Oxygen, pH and Temperature and Effluent Settleable Solids - Southeast Plant**

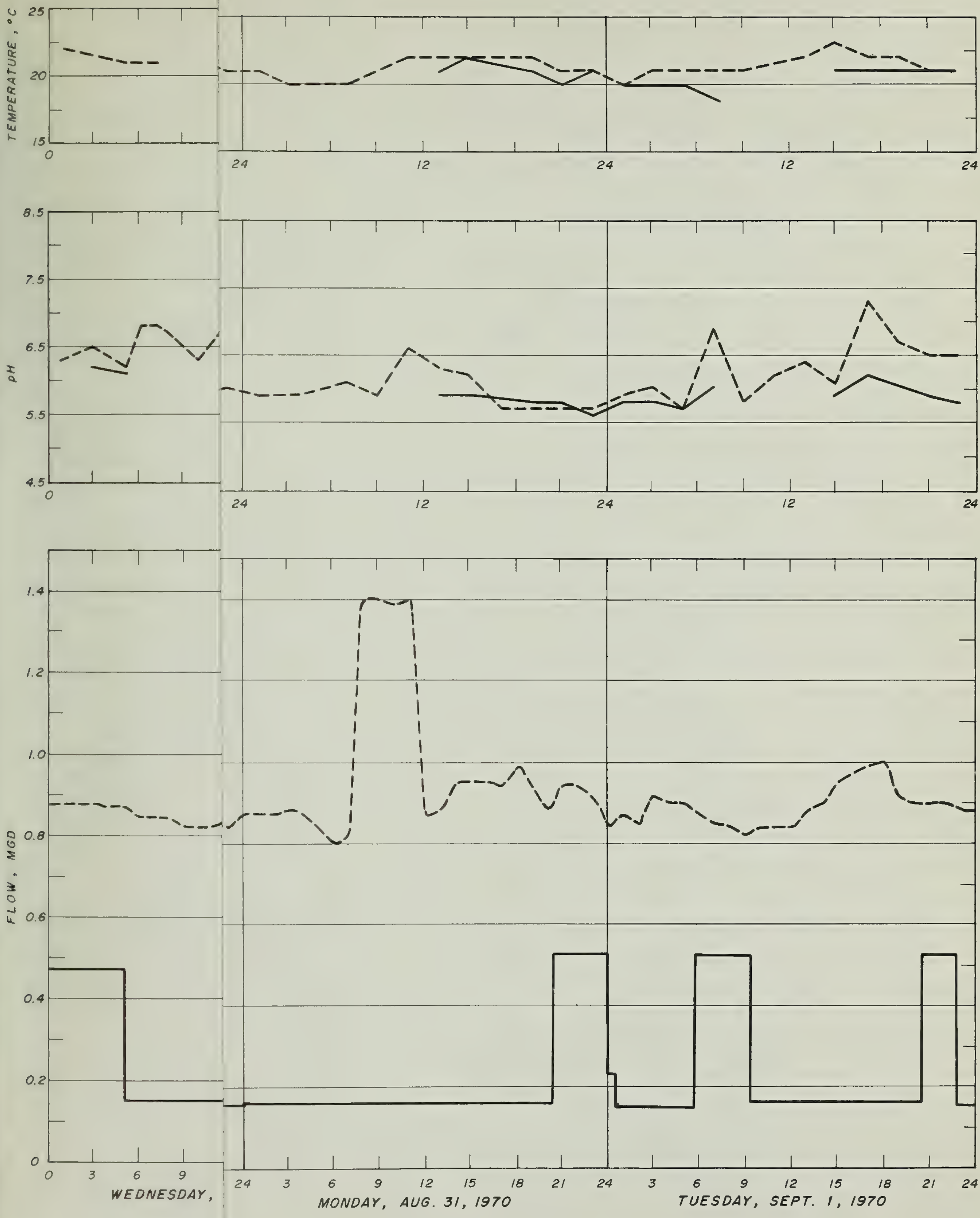

Fig. 3-13 **Hourly Variation in North Point and Southeast Raw Sludge Flow, pH and Temperature - Southeast Plant**

Foldout

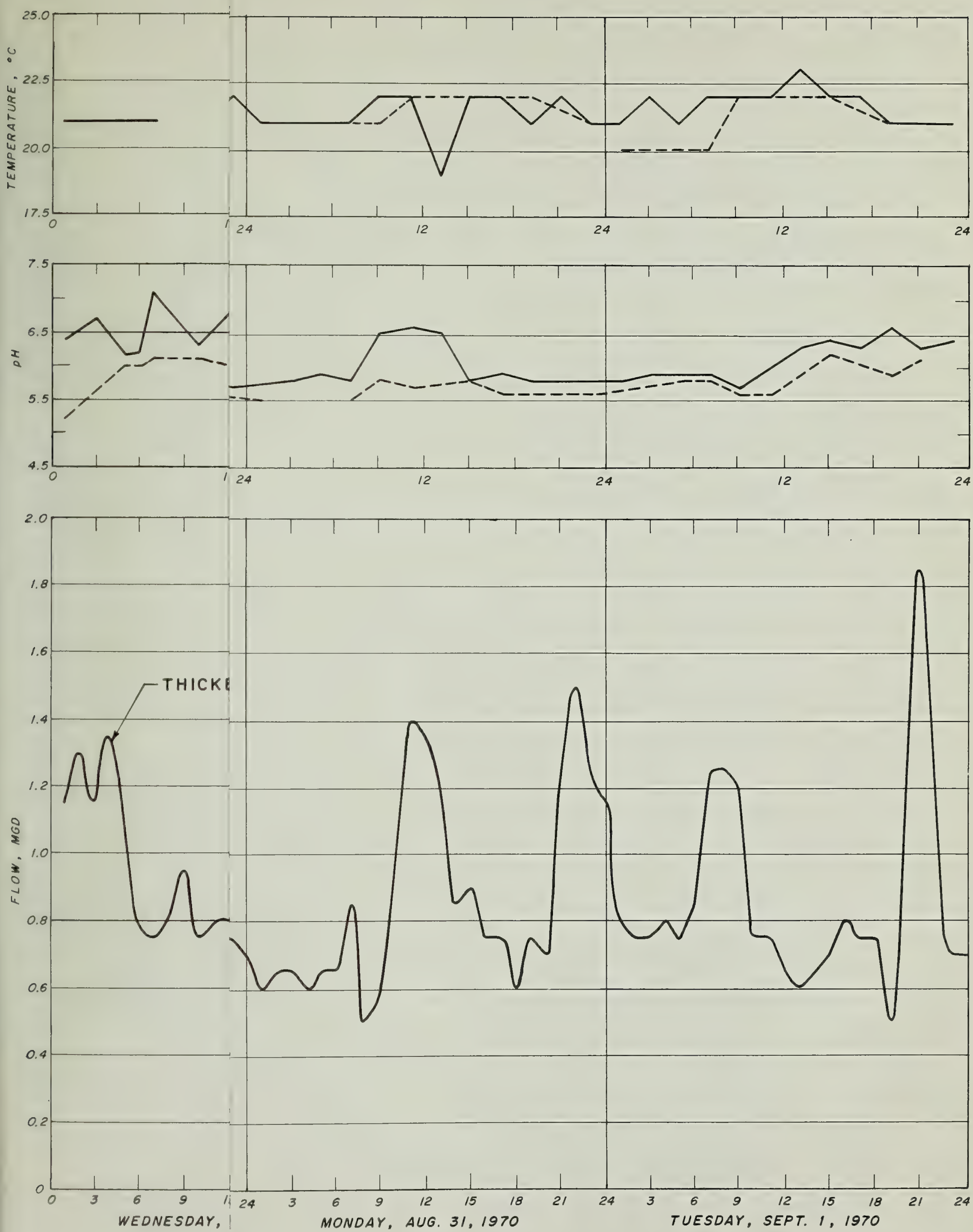

Fig. 3-14 Hourly Variation in Thickening Tank Overflow, pH and temperature and Thickened Sludge pH and Temperature - Southeast Plant

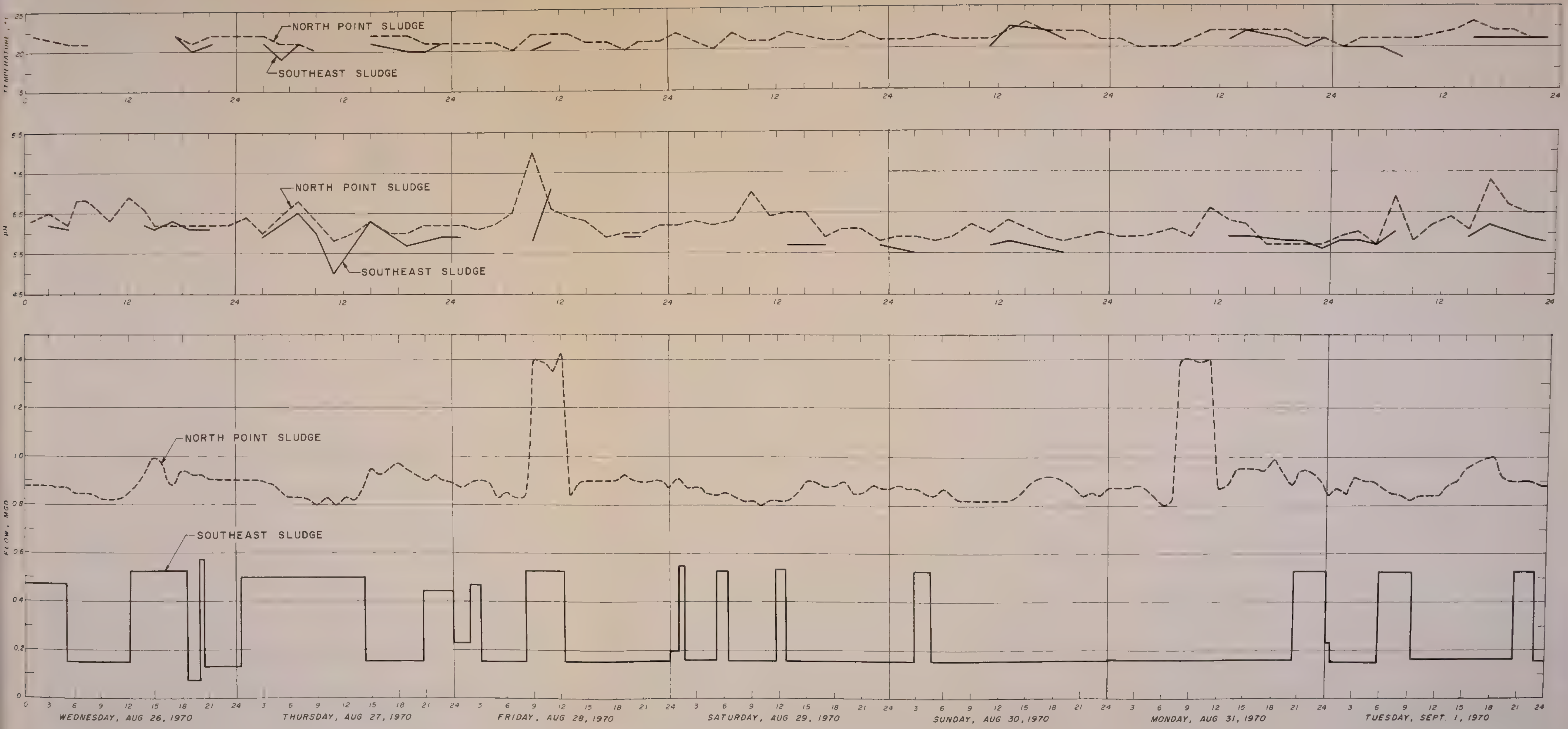

Fig. 3-13 Hourly Variation in North Point and Southeast Raw Sludge Flow, pH and Temperature - Southeast Plant

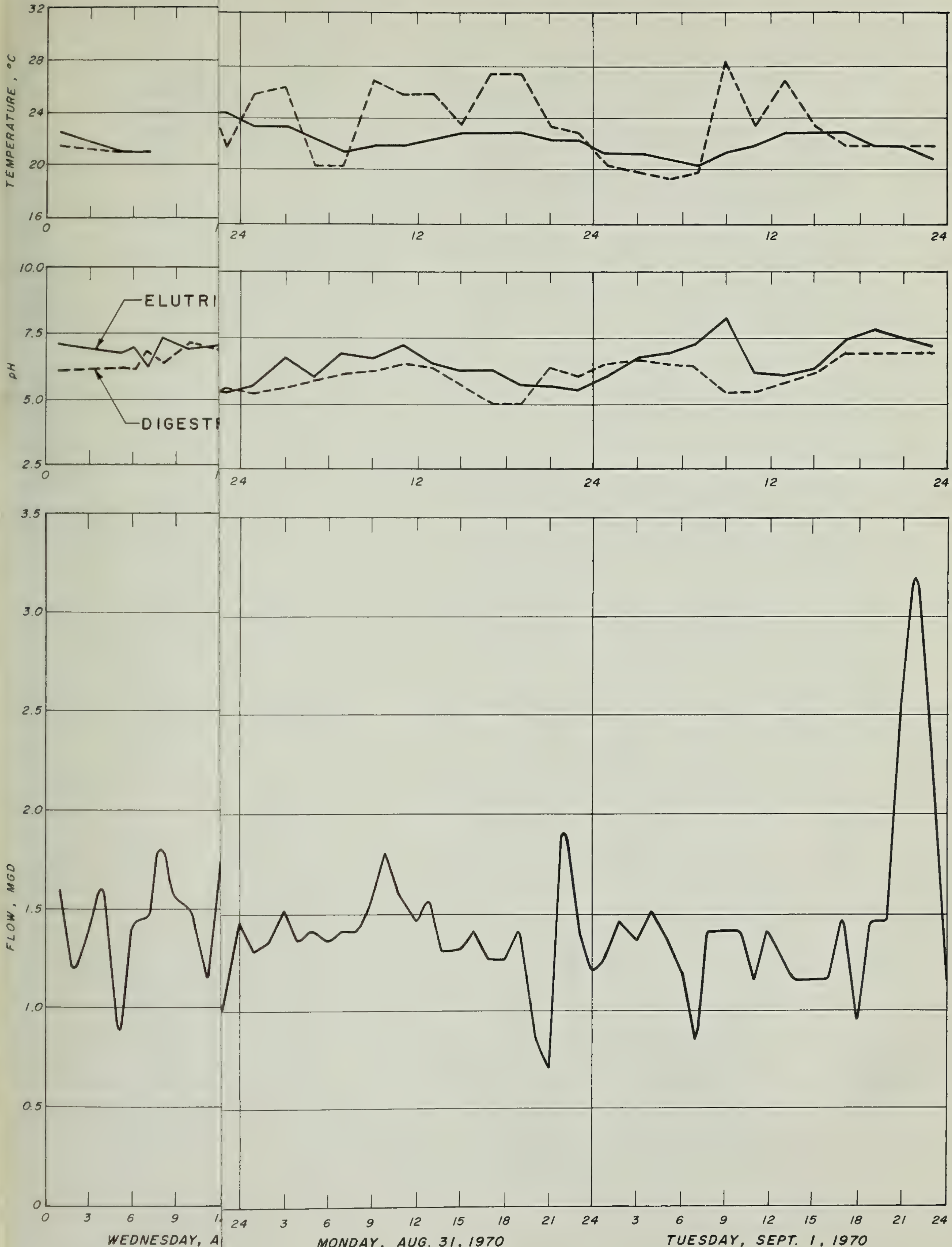

Fig. 3-15 **Hourly Variation in Elutriation Tank Overflow, pH and Temperature and Digested Sludge to Elutriation Tanks pH and Temperature - Southeast Plant**

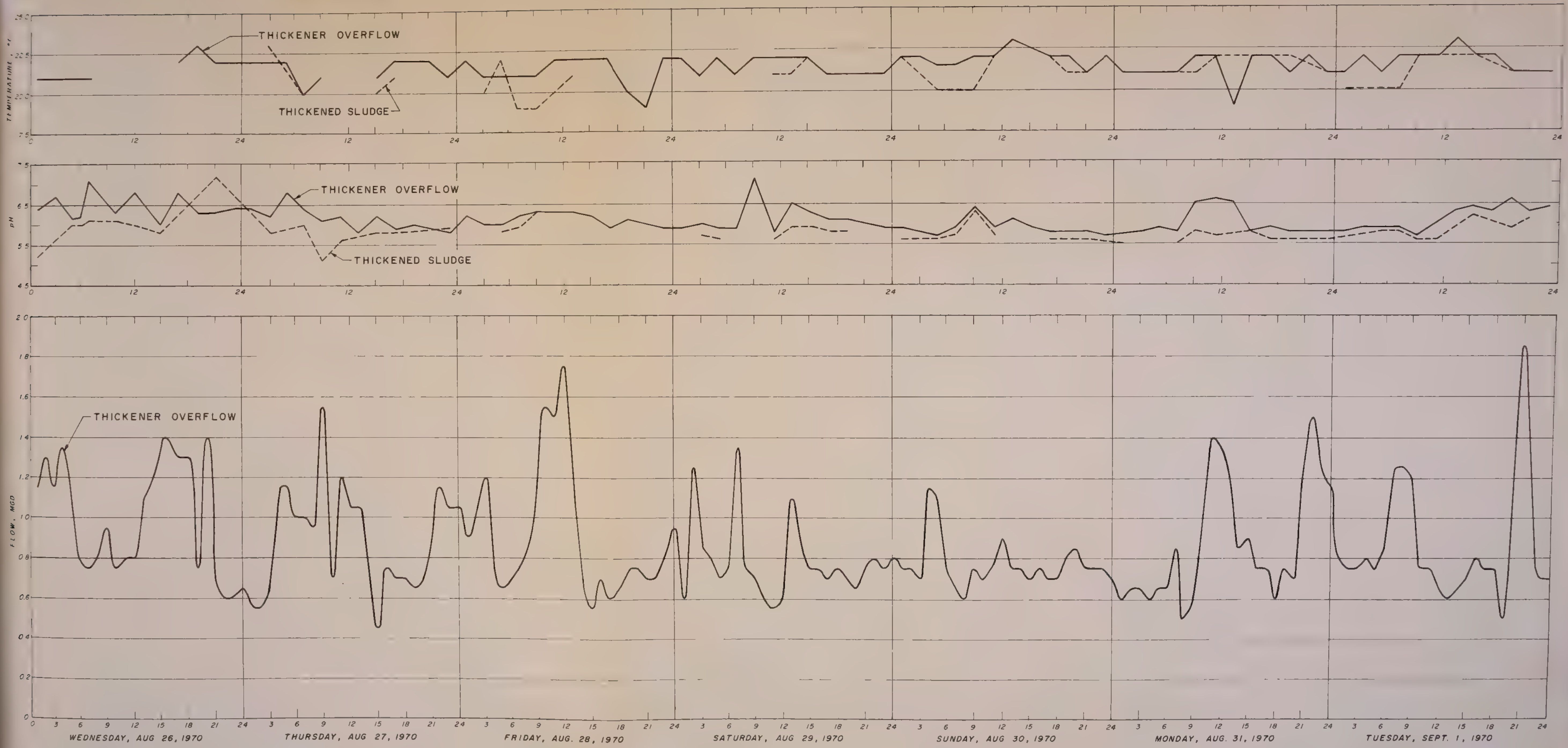

Fig. 3-14 Hourly Variation in Thickening Tank Overflow, pH and temperature and Thickened Sludge pH and Temperature - Southeast Plant

Table 3-25 Metallic and Other Trace Elements in 7-Day Composite Samples of Influent, Effluent, Thickening Tank Overflow, Elutriation Tank Overflow, Raw Sludge from North Point Plant, Raw Sludge From Southeast Plant, Thickened Sludge and Elutriated Sludge to Filter Day Tank - Southeast Plant

	Influent		Effluent		Thickener tank overflow		Elutriation overflow	
	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day
Iron	2.7	420	4.6	770	200	1350	27.3	317
Copper	0.35	57	0.38	61	7.0	48	0.27	3
Nickel	0.018	3	0.018	3	0.56	3.8	0.11	1.3
Chromium	1.8	280	0.74	120	56	380	2.7	32
Lead	0.035	6	0.037	6	2.8	19	0.055	0.6
Tin	-	-	-	-	0.84	6	0.055	0.6
Zinc	0.89	140	0.92	150	7.0	48	2.7	32
Cobalt	-	-	-	-	0.06	0.4	-	-
Silver	0.004	0.6	0.004	0.6	0.56	3.8	0.0022	0.3
Vanadium	0.02	3	0.018	3	0.28	1.9	0.055	0.6
Titanium	0.018	3	0.018	3	11	77	0.055	0.6
Bismuth	-	-	-	-	0.06	0.4	-	-
Strontium	0.53	85	0.55	93	0.84	6	0.82	9.5
Aluminum	0.89	140	0.92	150	98	670	6.8	79

	Raw sludge from North Point		Raw sludge from Southeast		Thickened sludge to digester		Elutriated sludge to filter O.T.	
	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day	mg/l	lb/day
Iron	200	1,500	1,200	2,560	1,600	4,650	1,200	510
Copper	5.0	38	44	95	57	170	35	15
Nickel	3.0	23	5.2	11	6.9	20	5.3	2.2
Chromium	5.0	38	440	950	570	1,700	350	150
Lead	3.6	27	14	30	23	67	18	7.3
Tin	2.0	15	5.2	11	9.1	27	5.3	2.2
Zinc	6.0	45	70	150	91	270	71	29
Cobalt	0.02	0.15	0.35	0.8	0.45	1.3	0.35	0.15
Silver	0.02	0.15	3.5	7.6	4.5	13	3.5	1.5
Vanadium	0.04	0.30	1.7	3.8	2.3	6.7	1.7	0.73
Titanium	3.0	22	70	150	110	330	88	37
Bismuth	0.06	0.45	0.35	0.8	0.68	2.0	0.53	0.22
Strontium	0.40	3.0	5.2	11	6.8	20	5.3	2.2
Aluminum	40	320	600	1,300	1,030	3,000	700	330

from a hydraulic balance of elutriation system components. Finally, Fig. 3-16 gives a plot of the sludge flow pumped from the secondary elutriation tanks to the filter equalizing tank prior to being fed to the vacuum filters. Flow figures were obtained in a special wooden measuring box provided with a Cipolleti weir. Due to its difficult handling characteristics, overflow from the scum concentrator was excluded from the measuring device. Also shown in Fig 3-16 are plots of pH and temperature for the elutriation sludge.

It is interesting to note how closely the elutriation tank overflows (Fig 3-15) correlate with the periods of little pumping of elutriation sludge to the filter equalizing tank (Fig 3-16). Even during periods of major elutriation sludge removal, such as the 12-hour period on Friday afternoon, the elutriation tank overflow still averaged over 1.25 mgd. Elutriation sludge pH is somewhat lower than either elutriation overflow or digested sludge pH, but not significantly so. Fig 3-15 shows that the higher digested sludge temperature is apparently completely dissipated in the elutriation tanks, resulting from the addition of 1.0 mgd No. 3 wash water flow to the 350,000 gallons per day digested sludge flow.

Mass Distribution - Sewage Treatment

A review of the plant flow diagram, Fig 2-5, indicates that for the Southeast plant the calcuable mass distribution in the primary treatment process

Table 3-26 Volume and Loadings of Raw Sludge, Thickened Sludge, Digested Sludge, Elutriated Sludge and Sludge Filter Cake - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-day average
Flow, mil gal								
North Point raw sludge	0.90	0.89	0.97	0.88	0.87	0.97	0.91	0.91
Southeast raw sludge	0.32	0.35	0.25	0.20	0.18	0.22	0.27	0.26
Thickened sludge	0.29	0.39	0.35	0.31	0.33	0.38	0.37	0.35
Digested sludge[a]	0.35	0.35	0.35	0.35	0.35	0.35	0.35	0.35
Elutriation sludge to filter	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Sludge filter cake, 1000 lbs (wet wt)	300	340	280	250	0	330	290	260
Total solids, 1000 lbs(dry wt)								
North Point raw sludge	68	66	57	48	58	33	49	54
Southeast raw sludge	120	110	100	120	100	96	100	110
Thickened sludge	97	140	110	310	360	220	230	210
Digested sludge	130	100	70	110	100	99	55	95
Sludge filter cake	85	97	76	68	0	94	70	70
Elutriation sludge to filter	18	24	21	8	0	9	24	15
Total volatile solids, 1000 lbs (dry wt)								
North Point raw sludge	47	47	41	36	41	24	36	39
Southeast raw sludge	80	71	70	81	69	65	69	72
Thickened sludge	69	95	75	210	240	150	160	140
Digested sludge	80	61	43	67	61	60	32	58
Sludge filter cake	41	43	37	38	0	50	35	35
Elutriation sludge to filter	10	13	12	5	0	5.6	12	8.2
Grease, 1000 lbs (dry wt)								
North Point raw sludge	-	3.5	17	-	-	-	10	10[b]
Southeast raw sludge	-	34	32	30	29	32	32	32[c]
Thickened sludge	-	27	31	26	39	26	55	34[c]
Digested sludge	-	22	9	34	42	20	11	23[c]
Sludge filter cake	1.3	1.1	0.7	1.5	0	2.6	0.6	1.1
Elutriation sludge to filter	-	2.7	3.8	0.6	0	3.0	4.8	2.4[c]
COD, 1000 lbs (dry wt)								
North Point raw sludge	120	110	110	60	57	110	110	100
Southeast raw sludge	160	170	150	130	130	160	190	160
Thickened sludge	150	180	150	210	200	170	250	190
Chlorides, as NaCl 1000 lbs (dry wt)								
North Point raw sludge	-	6.7	8.1	-	-	-	-	-
Southeast raw sludge	-	-	-	3.2	-	-	-	-
Thickened sludge	-	-	4.1	-	3.2	-	3.7	3.6[b]
Digested sludge	-	3.8	3.5	4.7	3.5	-	4.4	3.9[d]
Elutriation sludge to filter	-	0.63	0.76	0.76	0	0.59	0.80	0.59[c]
Sulfides, 1000 lbs (dry wt)								
North Point raw sludge	0.12	0.16	0.26	0.18	0.13	0.32	0.35	0.22
Southeast raw sludge	0.30	0.18	0.47	0.40	0.96	0.74	1.10	0.60
Thickened sludge	0.53	0.36	0.63	0.60	0.55	0.70	0.80	0.60

[a] Estimated flow values.
[b] 3-day average.
[c] 6-day average.
[d] 5-day average.

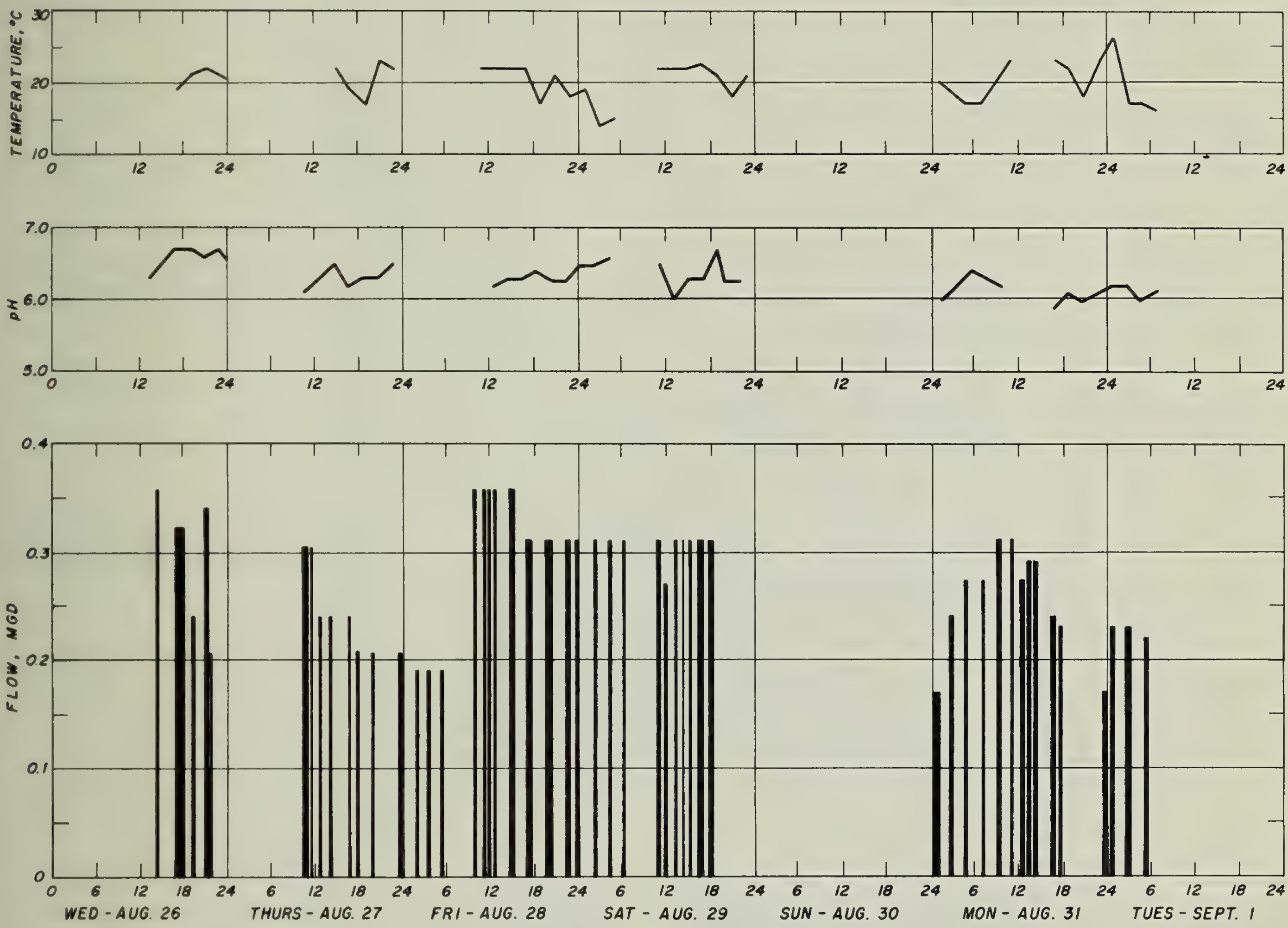

Fig. 3-16 Hourly Variation in Elutriation Sludge Flow, pH and Temperature - Southeast Plant

Table 3-27 Solids Mass Distribution[a] in the Sewage Treatment Process - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-day average
				Suspended solids, 1000 lb/day				
Influent	77	78	83	59	42	59	82	
Elutriation tank overflow	21	37	40	44	48	56	15	
Thickening tank overflow	85	57	51	44	20	56	-	
Mass in	183	172	174	147	110	171	-	160[c]
Effluent	63	36	47	41	35	48	60	
Raw sludge[b]	117	107	98	117	98	94	98	
Mass out	180	143	145	158	123	142	158	150[c]
				Volatile suspended solids, 1000 lb/day				
Influent	67	63	73	53	31	48	65	
Elutriation tank overflow	15	23	25	29	33	35	9	
Thickening tank overflow	64	42	38	33	15	42	-	
Mass in	146	128	136	115	79	125	-	120[c]
Effluent	52	26	36	29	25	35	49	
Raw sludge[b]	79	70	69	80	68	65	68	
Mass out	131	96	105	109	93	100	117	110[c]
				Grease, 1000 lb/day				
Influent	14	19	23	7.3	9.5	16	23	
Elutriation tank overflow	2.9	12	6.7	4.8	13	11	2.3	
Thickening tank overflow	7.0	7.9	33	4.5	3.6	7.4	-	
Mass in	23.9	38.9	62.7	16.6	26.1	20.0	-	33[d]
Effluent	11	12	13	4.4	9.7	11	14	
Raw sludge[b]	-	33.7	30.7	29.7	28.8	31.7	31.7	
Mass out	-	45.7	43.7	24.1	38.5	42.7	-	39[d]

[a] Mass (influent) + mass (elutriation tank overflow) + mass (thickening tank overflow) = mass (effluent) + mass (raw sludge).

[b] NaCl corrected.

[c] 6-day average.

[d] 5-day average.

involves the relationship between the plant influent, effluent, raw sludge and the returned flows from the thickening and elutriation tanks. Table 3-27 shows the results of these calculations for applicable solids measurements. The rather close balance between mass in and mass out seems to verify previous observations and calculations.

Mass Distribution - Solids Treatment

Solids mass distributions have been made for the sludge thickening and digested sludge elutriation systems. The results of these calculations are given in Tables 3-28 and 3-29, respectively. In evaluating the results shown in these tables, three important factors should be borne in mind: (1) the thickening and elutriation tanks provide solids storage capacity within each system; (2) it was not possible to obtain measured flow values for thickened sludge, digested sludge to elutriation tanks, elutriation wash water and filtrate; (3) it was not possible to obtain samples of the filtrate flow to the elutriation tanks; (4) it was difficult to get reliable representative samples of thickened sludge to the digesters; and (5) sludge digestion has already started in the thickening tanks and continues in the elutriation tanks, as evidenced by the raising of large solids mats which accumulate on the surfaces of the tanks in both systems. Often these large solids mats overtax the capacity of the existing scum handling equipment and must be broken up and carried out by the overflow systems.

All values not directly measured in the field have been either computed from other field measurements or estimated based on information collected at the treatment plant. Under these circumstances the widely divergent results of these mass distribution table is not difficult to understand.

Table 3-28 Solids Mass Distribution[a] in the Sludge Thickening System - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-day average
				Suspended solids, 1000 lb/day				
North Point sludge[b]	61	57	49	41	52	30	42	
Southeast sludge[b]	117	107	98	117	98	94	98	
Mass in	178	164	147	158	150	124	140	150[c]
Thickened sludge[b]	96	138	106	307	357	216	227	
Thickening tank overflow	85	57	57	44	20	56	-	
Mass out	181	195	163	351	377	272	-	260[c]
				Volatile suspended solids, 1000 lb/day				
North Point sludge[b]	44	41	38	34	38	23	34	
Southeast sludge[b]	78	70	69	79	68	64	68	
Mass in	122	111	107	113	106	87	102	110[c]
Thickened sludge[b]	66	92	72	207	237	147	157	
Thickening tank overflow	64	42	38	33	15	42	-	
Mass out	130	134	110	240	252	189	-	180[c]
				Grease, 1000 lb/day				
North Point sludge[b]	-	3.4	16	-	-	-	9.5	
Southeast sludge[b]	-	33.7	31.7	29.7	28.2	31.7	31.7	
Mass in	-	37.1	33.3	-	-	-	41.2	35[d]
Thickened sludge[b]	-	26.5	30.5	25.6	38.5	25.6	54.5	
Thickening tank overflow	7.0	7.9	33	4.5	3.6	7.4	-	
Mass out	-	34.4	63.5	30.1	41.1	33.0	-	49[d]

[a] Mass (Southeast sludge) + mass (North Point sludge) = mass (thickened sludge) + mass (thickening tank overflow).

[b] NaCl corrected.

[c] 6-day average.

[d] 2-day average.

Table 3-29 Solids Mass Distribution[a] in the Sludge Elutriation System - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-Day average
	Suspended solids, 1000 lb/day							
Digested sludge[b]	126	96	66	105	96	95	51	
Filtrate[c]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
No. 3 water	3.1	1.8	2.3	2.0	1.7	2.4	3.0	
Mass in	129	98	69	107	98	98	54	94
Elutriation sludge[b]	17.2	23.4	20.2	7.2	0	8.4	23.2	
Elutriation tank overflow	21	37	40	44	48	56	15	
Scum[d]	0.8	1.1	1.0	0.3	0	0.4	1.1	
Mass out	39	62	61	52	48	65	39	53
	Volatile suspended solids, 1000 lb/day							
Digested sludge[b]	77	59	42	65	59	58	31	
Filtrate[c]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
No. 3 water	2.6	1.3	1.8	1.4	1.3	1.8	2.5	
Mass in	80	61	44	67	61	60	34	58
Elutriation sludge[b]	9.7	12.7	11.7	4.9	0	5.5	11.7	
Elutriation tank overflow	15	23	25	29	33	35	9	
Scum[d]	0.4	0.6	0.5	0.2	0	0.2	0.5	
Mass out	25	36	37	34	33	41	21	32
	Grease, 1000 lb/day							
Digested sludge[b]	-	22	9	34	42	20	11	
Filtrate	.002	.002	.002	.002	.002	.002	.002	
No. 3 water	0.6	0.6	0.7	0.2	0.5	0.6	0.7	
Mass in	-	23	9.7	34	43	21	12	24[e]
Elutriation sludge	-	2.7	3.8	0.6	0	3.0	4.8	
Elutriation overflow	2.9	12	6.7	4.8	13	11	2.3	
Scum[d]	-	0.1	0.2	0.03	0	0.2	0.3	
Mass out	-	15	11	5.4	13	14	6.4	11[e]

[a] Mass (digested sludge) + mass (filtrate) + mass (No. 3 water) = mass (elutriated sludge) + mass (elutriation overflow) + mass (scum).

[b] NaCl corrected.

[c] Filtrate loading estimated.

[d] Scum loading estimated.

[e] 6-day average.

Table 3-30 Comparison of Study and Plant Analytical Results, Influent - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-day average
Total solids, mg/l								
Study	4300	4000	3500	3500	3700	3200	3300	3700
Plant	3700	4160	2050	4140	3840	3360	3130	3480
Suspended solids, mg/l								
Study	460	470	500	390	300	360	490	420
Plant	352	288	366	414	254	311	404	342
Grease, mg/l								
Study	84	117	140	48	68	100	140	93[a]
Plant	115	-	127	137	-	134	-	128[a]
5-day BOD, 20°C mg/l								
Study	360	300	300	170	130	320	330	280[b]
Plant	319	-	-	302	-	264	-	295[b]
COD, mg/l								
Study	890	890	910	790	480	760	820	830[c]
Plant	1140	-	-	-	-	749	-	940[c]
Alkalinity, mg/l								
Study	235	152	-	161	155	180	150	170[d]
Plant	132	150	128	150	122	146	158	143[d]

[a] 4-day average.

[b] 3-day average.

[c] 2-day average.

[d] 6-day average.

Comparisons with Routine Analysis

Tables 3-30, 3-31 and 3-32 tabulate daily composite results over the sampling period for those influent, effluent and filter cake analysis which coincide with the routine laboratory analysis performed by plant personnel during the sampling period. Review of these comparisons indicates that although all seem to vary a bit all except the influent and effluent suspended solids and alkalinity fall within expected sampling and laboratory techniques and tolerances. Both influent and effluent suspended solids study results are significantly higher than similar plant measurements. Several reasons for these differences have already been discussed.

Except for the differences mentioned above it is expected that the routine laboratory analyses performed by plant personnel may be utilized in determining the long-range characteristics and yearly variations for the Southeast plant.

Plant Performance

Table 3-33 presents a summary of plant removal efficiencies for suspended solids, grease, BOD and COD. Because of the loading imposed on the plant by the return flows, two sets of efficiencies have been determined. The first set is based simply on influent and effluent loadings and indicates an average removal of suspended solids (32 percent), BOD (29 percent) and COD (23 percent) which is considerably below the accepted range for primary treatment plants. The second set of efficiencies is based on the influent plus return loadings in and effluent loadings out and indicates an average removal of suspended solids (70 percent), BOD (61 percent) and COD (67 percent) which is considerably above the accepted range for primary treatment plants. Grease removal for the first set of efficiencies at 31 percent is good, but its 70 percent efficiency under the second set is phenomenal.

Table 3-31 Comparison of Study and Plant Analytical Results, Effluent - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-Day average
Total solids, mg/l								
Study	3300	3200	3400	3700	3800	3400	3300	3400
Plant	3160	3460	1810	3710	3710	3320	3360	3220
Suspended solids, mg/l								
Study	360	210	270	260	240	280	340	280
Plant	195	170	138	228	207	215	223	196
Percent removed								
Study	22	55	46	33	13	22	31	33
Plant	44	41	62	45	18	31	45	43
Grease, mg/l								
Study	60	1.5	77	28	66	65	80	62[a]
Plant	78	–	64	63	–	71	77	70[a]
5-day BOD, 20°C, mg/l								
Study	210	72	200	150	140	160	300	170[b]
Plant	222	–	194	194	–	242	–	219[b]
Percent removed								
Study	42	76	33	12	–	50	9	35[b]
Plant	30	–	–	36	–	8	–	25[b]
COD, mg/l								
Study	770	660	680	540	460	500	630	630[c]
Plant	698	–	–	–	–	637	–	668[c]
Alkalinity, mg/l								
Study	175	184	210	205	237	235	200	210
Plant	126	144	127	134	156	138	118	135

[a] 5-day average

[b] 3-day average.

[c] 2-day average.

Table 3-32 Comparison of Study and Plant Analytical Results, Sludge Filter Cake - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-day average
Total solids, percent								
Study	29	29	27	27		28	24	27[a]
Plant	25.3	25.3	25.4	26.5		25.6	21.5	25.0[a]
Volatile solids, Percent total solids								
Study	48.2	45.0	48.2	55.6		53.5	50.0	50.0[a]
Plant	46.4	43.0	45.5	43.0		44.6	39.5	43.7[a]

[a] 6-day average.

Table 3-33 Summary of Plant Removal Efficiency - Southeast Plant

	Wednesday 8/26	Thursday 8/27	Friday 8/28	Saturday 8/29	Sunday 8/30	Monday 8/31	Tuesday 9/1	7-Day average
	Suspended solids, 1000 lb/day							
Influent	77	78	83	59	42	59	82	69
Effluent	63	36	47	41	35	48	60	47
Removed (inf.-eff.)	18	42	36	18	7	11	22	22
Efficiency, percent[a]	22	54	43	30	17	19	27	32
Thickening tank overflow	85	57	51	44	20	56	-	59[c]
Elutriation tank overflow	21	37	40	44	48	56	15	41[c]
Influent, plus overflows	183	172	174	147	110	171	-	166[c]
Removed (inf.+ov.-eff.)	120	136	127	106	75	123	-	115[c]
Efficiency, percent[b]	65	79	73	72	68	72	-	70[c]
	Grease, 1000 lb/day							
Influent	14	19	23	7.3	9.5	16	23	16
Effluent	11	12	13	4.4	9.7	11	14	11
Removed (inf.-eff.)	3	6	10	2.9	-0.2	5	9	5
Efficiency, percent[a]	21	32	44	40	-2	31	39	31
Thickening tank overflow	7.0	7.9	33	4.5	3.6	7.4	-	10[c]
Elutriation tank overflow	2.9	12	6.7	4.8	13	11	2.3	8.4[c]
Influent, plus overflows	23.9	38.9	62.7	16.6	26.1	34.4	-	33.2[c]
Removed (inf.+ov.-eff.)	13.9	26.9	49.7	12.2	16.4	23.4	-	23.7[c]
Efficiency, percent[b]	58	69	79	73	63	68	-	70[c]
	BOD, 1000 lb/day							
Influent	60	50	50	26	18	53	55	45
Effluent	37	26	35	24	21	28	53	32
Removed (inf.-eff.)	23	24	15	2	-3	25	2	13
Efficiency, percent[a]	38	48	30	8	-17	47	4	29
Thickening tank overflow	19	21	36	10	35	20	37	25
Elutriation tank overflow	9.1	11	13	16	16	18	7.0	13
Influent, plus overflows	88.1	82	89	52	69	91	99	83
Removed (inf.+ov.-eff.)	51.1	56	54	28	48	63	46	51
Efficiency, percent[b]	58	68	61	54	70	69	47	61
	COD, 1000 lb/day							
Influent	150	150	150	120	67	130	140	130
Effluent	130	110	120	86	68	87	110	100
Removed (inf.-eff.)	20	40	30	34	-1	43	30	30
Efficiency, percent[a]	13	27	20	28	-1.5	33	21	23
Thickening tank overflow	200	140	130	77	52	68	130	110
Elutriation tank overflow	110	92	86	58	59	18	20	63
Influent, plus overflows	460	382	366	255	178	216	290	303
Removed (inf.+ov.-eff.)	330	272	246	169	110	129	180	203
Efficiency, percent[b]	72	71	67	66	62	60	62	67

[a] Efficiency based on raw sewage influent and primary sedimentation tank effluent.

[b] Efficiency based on raw sewage influent plus plant returns to primary sedimentation tank and primary sedimentation tank effluent.

[c] 6-day average.

Table 3-34 Comparison of Bioassay Results - North Point, Richmond - Sunset and Southeast Plants

Analysis	Influent 24-hour composite			Effluent 24-hour composite		
	Maximum day, percent	Minimum day, percent	7-day average percent	Maximum day, percent	Minimum day percent	7-day average percent
	North Point Plant					
TL_m^{96}	> 100	47	76	>100	50	77
96-hour survival	80	0	21	90	0	29
	Richmond-Sunset Plant					
TL_m^{96}	75	22	47	40	16	23
96-hour survival	0	0	0	0	0	0
	Southeast Plant					
TL_m^{96}	> 100	63	82	80	63	68
96-hour survival	90	0	38	0	0	0

BIOASSAY RESULTS

Bioassay results for all three plants have been tabulated in Table 3-34 for comparison purposes. Only the North Point plant shows some improvement in both 96 hr TLm and 24 hr survival between influent and effluent samples. Both the average 96 hr TLm of 77 percent and the average 24 hr survival of 50 percent for the effluent sample were one percentage point higher than for the influent sample.

Richmond-Sunset results indicate a major increase in toxicity takes place as the sewage passes through the plant. The seven-day average 96 hr TLm for the effluent at 23 percent is slightly less than half the influent figure of 47 percent while the 24 hr survival of 1.4 percent is less than one-third the influent figure of six percent.

When compared to the other two plants with their relative light loadings, Southeast results are the best of the group. The seven-day average 96 hr TLm of 68 percent and the 24 hr survival of 46 percent for the influent is only slightly less than the North Point averages.

The poorest results for both the North Point and Southeast plants fall on the weekend periods of minimum flow, when the majority of the sewage in these systems may be assumed to come from domestic sources. Bioassay results of the domestic wastes at Richmond-Sunset do not indicate any significant variation of toxicity throughout the week.

APPENDIX A-1

ABBREVIATIONS

Abbreviations to be found in this report are listed below in order of their first use:

%	percent
mg	milligram, milligrams
l	liter, liters
mg/l	milligrams per liter
ml/l/hr	milliliters per liter per hour
Fig.	figure
mgd	million gallons per day
min	minimum
avg	average
max	maximum
lb	pound, pounds
BOD	biochemical oxygen demand (5 day, 20 C)
cu ft/mil gal	cubic feet per million gallons
gpm/pump	gallons per minute per pump
rpm	revolutions per minute
ton/hr/total	total tons per hour
cfm	cubic feet per minute
cu ft	cubic feet
gpm/total	total gallons per minute
cfm/blower	cubic feet per minute per blower
gal/sq ft/day	gallons per square feet per day
fpm	feet per minute
lb/in	pounds per square inch
in x ft	inches by feet
lb/day/evaporator	pounds per day per evaporator
lb/day/chlorinator	pounds per day per chlorinator
lb/mil gal	pounds per million gallons
cu ft/sump	cubic feet per sump
fps	feet per second
cfm/fan	cubic feet per minute per fan
lb/min/cleaner	pounds per minute per cleaner
in.	inch, inches
No.	number
ft	foot, feet

min	minute, minutes
hr	hour, hours
mil	million
gal	gallon, gallons
PWWF	peak wet weather flow
lb dry solids/day	pounds dry solids per day
lb dry solids/cu ft/day	pounds dry solids per cubic feet per day
lb/day	pounds per day
cu ft/lb	cubic feet per pound
cu ft/day	cubic feet per day
Btu/hr/heater	British thermal units per hour per heater
F	degrees Fahrenheit
lb/day total	total pounds per day
ft x ft	feet by feet
psi	pounds per square inch
C	degrees Celsius (formerly centigrade)
TICH	total identifiable chlorinated hydrocarbons
Cl	chlorides
pH	hydrogen ion concentration
DO	dissolved oxygen
Temp	temperature
lab	laboratory
a.m.	morning hours
$CuSO_4$	copper sulfate
$HgCl_2$	mecuric chloride
COD	chemical oxygen demand
pres	preserve
NaOH	sodium hydroxide
AA	atomic absorption
SS	suspended solids
Cl_2	chlorine
ZnAc	zinc acetate
SE	southeast
ORP	oxidation reduction potential
Mon	Monday
Thurs	Thursday
Figs	figures
TL_m's	median tolerance limit; defined as the waste concentration, expressed in percent, at which half of the test organisms die in the stated time

NH_3	ammonia
NO_3^-	nitrate
NO_2^-	nitrate
N	nitrogen
P	phosporus
PO_4	phosphate
DDE	2,2-Dichloro-2, 2-bis (p-chlorophenyl) ethylene
DDD	1,1-Dichloro-2, 2-bis (p-chlorophenyl) ethane (sometimes called TDE)
DDT	1, 1, 1-Trichloro-2, 2-bis (p-chlorophenyl) ethane
TS	total solids
$CaCO_3$	calcium carbonate
wt	weight
inf	influent
eff	effluent
ov	overflows
ppm	parts per million
ppb	parts per billion
MPN	most probable number (of coliform organisms)

APPENDIX B-1

LABORATORY ANALYSES

METHODS USED - NORTH POINT WPCP

Total Solids and Volatile Solids

"Standard Methods fo r the Examination of Water and Wastewater", American Public Health Association, 12th edition (1965).

Suspended and Volatile Suspended Solids

Standard Methods, using asbestos pad in crucibles, using 100 ml samples except as follows: 50 ml - Lab. No. 11588, 11593, 11577, 11586, 11602.

Floatables

Method prepared for Division of Water Supply and Pollution Control, U.S. Public Health Service, by Engineering-Science, Inc., (Contract WPD 12-64). Beginning with the samples of August 3, the final wash with 500 ml of distilled water was omitted.

Grease

Hexane extraction, using a Goldfish (Laboratory Construction Co., Kansas City, Mo.) extraction apparatus, 1000 ml samples used.

5-Day, 20 C., BOD

Standard Methods

COD

Standard Methods

Chlorides

Standard Methods, mercuric chloride method

Nitrate

Brucine method, FWPCA Methods for Chemical Analysis of Water and Wastes (Nov., 1969), p. 165.

Nitrite

Standard Methods

Ammonia

Distillation and titration according to Standard Methods, but using Lab Con Co micro steam distillation apparatus with 50 ml samples.

Organic Nitrogen

Standard Methods, but using Lab Con Co. micro digestion and micro steam distillation apparatus with 50 ml samples.

Total Dissolved Phosphate

Standard Methods, molybdenum blue procedure with stannous chloride as reductant, following acid hydrolysis.

Total Phosphorus

Oxidation with sulfuric and nitric acids, followed by molybdenum blue procedure with stannous chloride as reductant, according to Standard Methods

Phenols

Standard Methods, distillation followed by 4-aminoantipyrine method, chloroform extraction.

Settleable Matter

Standard Methods

Turbidity

Hach #2100 Turbidimeter

Chlorine Demand

Replicate aliquats treated with increasing dosages of standard chlorine water, then spot-tested with o-tolidine reagent periodically to determine presence or absence of residual chlorine.

Total Sulfides

Standard Methods, Colorimetric method.

Bio-Assays

Standard Methods, using Threespine Sticklebacks, and Steinhart Aquarium Filtered Sea Water as dilution water.

Pesticides

Petroleum ether extraction, Florisil column clean--up, gas chrometography by use of Varian 2100 Electron Gas Chromatograph.

All samples also run through procedure after spiking with known amounts of pesticides.

Lead and Aluminum

By AAS (Atomic Absorption Spectrophotometry).

Mineral Analysis

Standard Methods

METHODS USED - RICHMOND SUNSET WPCP

Total Suspended and Volatile Suspended Solids

Standard Methods - asbestos pad
All influent samples - 50 ml aliquots
All effluent samples - 100 ml aliquots
All elutriation overflow samples - 25 ml aliquots

Alkalinity (Sludge Supernatant)

Standard Methods

Iron

By AAS

Cadmium

By AAS

Other Analyses

Same as North Point methods.

METHODS USED - SOUTHEAST WPCP

Total Suspended and Volatile Suspended Solids

Standard Methods - asbestos pad
All influent samples - 50 ml aliquots
All effluent samples - 100 ml aliquots
(except Anal. No. 11838, 50 ml aliquot)
All thickening tank overflow samples and all elutriation tank overflow samples - 25 ml aliquots.

Other Analyses

Same as North Point and Richmond-Sunset methods.

METHODS USED - SOUTHEAST RECEIVING WATERS

Dissolved Oxygen

Winkler method.
Samples dosed in field (azide alkaline - iodide reagent), and titration carried out in Laboratory with 0.025 N sodium thiosulfate, startch end-point (See Standard Methods).

BOD

On undiluted samples. Residual dissolved oxygen by azide modification of Winkler method (See Standard Methods).

APPENDIX C-1

NORTH POINT LABORATORY DATA SHEETS

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WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 7/30 - 8/5/70

Report to Brown and Caldwell, Consulting Engineers Date Received 7/30 - 8/5/70

Copies to San Francisco Department of Public Works Date Reported 10/26/70

Analysis No.	11541	11552	11559	11572	11579	11588	11602
Source of Sample	NORTH POINT WATER POLLUTION CONTROL PLANT Daily Composites of Plant Influent						
	7/30	7/31	8/1	8/2	8/3	8/4	8/5
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
otal solids	1300	1300	1340	1300	1300	1300	1200
otal volatile solids	580	590	580	340	380	380	330
otal suspended solids	190	200	160	160	–	220	230
olatile suspended solids	160	170	130	140	–	210	220
loatables	0.4	0.3	Nil	-	1.8	3.5	10
rease	69	65	52	38	60	11	67
-Day BOD, $20^\circ C$	200	190	170	160	210	220	220
OD	440	540	460	390	540	520	-
hlorides (as NaCl)	860	770	860	830	1000	820	840
itrate (as N)	0.3	2.8	2.7	2.0	2.4	1.1	4.1
itrite (as N)	0.08	0.14	0.07	0.07	0.11	0.15	0.15
mmonia (as N)	13.9	14.1	15.1	14.6	14.8	14.1	14.7
rganic nitrogen (as N)	15.1	18.6	15.1	15.7	20.1	16.8	15.5
otal nitrogen (as N)	29.4	35.6	33.0	32.4	37.4	32.2	34.5
otal dissolved phosphate (as PO_4)	19	20	23	22	24	22	19
otal phosphorus (as PO_4)	26	26	27	28	29	31	26
henols (C_6H_5OH)	0.071	0.067	0.052	0.030	0.056	0.063	0.046
ettleable matter, ml/l/hr	8.0	7.5	8.0	3.7	6.0	5.0	3.5
ettleable matter, mg/l/hr	96	110	70	91	56	140	180
urbidity, JTU	64	57	52	44	54	52	46

Comments:

Reported by Morris Lipschutz

North Point Water Pollution Control Plant
Daily Composites of Plant Influent

Comments:

Floatables test on Analysis No. 11572 ruined.

COD result for Analysis No. 11602 is of doubtful validity and is not reported.

Turbidity measurements were made after 1 hour settling in laboratory.

Beginning with the samples of August 3, the test for floatables was modified by omitting the final wash with 500 ml. of distilled water.

Total suspended solids and volatile suspended solids results for Analysis No. 11579 are of doubtful validity and are not reported.

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BROWN AND CALDWELL LABORATORIES

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Copies to San Francisco Department of Public Works — Date Reported 10/26/70

Analysis No.	11540	11553	11560	11573	11580	11589	11603
Source of Sample	NORTH POINT WATER POLLUTION CONTROL PLANT Daily Composites of Plant Effluent						
	7/30	7/31	8/1	8/2	8/3	8/4	8/5
DETERMINATION	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
Total solids	1300	1300	1300	1300	-	1200	1200
Total volatile solids	400	330	330	270	350	290	380
Total suspended solids	77	110	-	66	90	-	-
Volatile suspended solids	63	82	74	58	85	-	-
Floatables	2.0	0.3	Nil	1.5	2.1	5.8	2.5
Grease	36	41	19	35	40	54	44
5-Day BOD, 20°C	170	160	130	120	160	180	170
COD	330	380	340	270	390	310	260
Chlorides (as NaCl)	890	850	900	920	-	890	810
Nitrate (as N)	0.4	2.6	2.4	2.3	1.5	1.5	2.7
Nitrate (as N)	0.06	0.11	0.04	0.05	0.10	0.15	0.16
Ammonia (as N)	14.1	15.0	15.0	15.2	15.4	12.9	13.4
Organic nitrogen (as N)	11.7	15.9	11.7	10.5	18.4	13.2	15.7
Total nitrogen (as N)	26.3	33.6	29.1	28.1	35.4	27.8	32.0
Total dissolved phosphate (as PO_4)	18	20	22	19	19	20	21
Total phosphorus (as PO_4)	26	25	25	25	28	24	26
Phenols (As C_6H_5OH)	0.077	0.062	0.044	0.018	0.045	0.110	0.044
Settleable matter, ml/1/hr	0.1	0.2	0.5	0.1	0.2	0.1	0.1
Settleable matter, mg/1/hr	7	8	-	30	34	41	89
Turbidity, JTU	55	58	48	43	55	53	53

Comments:

Reported by Morris Lipschutz

North Point Water Pollution Control Plant
Daily Composites of Plant Effluent

Comments:

Analysis No. 11560. The result for volatile suspended solids is questionable, and is not reported. The value for settleable matter by weight is also not reported.

Analysis No. 11580. The results for total solids and for chlorides as NaCl are questionable, and are not reported.

Analysis No. 11603. The results for total suspended solids and volatile suspended solids are questionable and are not reported.

Floatables. Beginning with the samples of August 3, the test was modified by omitting the final wash with 500 ml. of distilled water.

Total suspended solids and volatile suspended solids results for Analysis No. 11589 are of doubtful validity and are not reported.

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BROWN AND CALDWELL LABORATORIES

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Copies to San Francisco Department of Public Works Date Reported 10/26/70

Analysis No.	11533	11543	11557	11565	11577	11586	11593
Source of Sample	NORTH POINT WATER POLLUTION CONTROL PLANT Grab Sample of Plant Influent at Peak Flow						
	7/30	7/31	8/1	8/2	8/3	8/4	8/5
DETERMINATION	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
Total solids	1100	980	820	1100	840	870	830
Total volatile solids	310	530	440	350	330	400	360
Total suspended solids	240	280	250	160	250	260	300
Volatile suspended solids	200	210	190	140	210	210	250
Floatables	0.3	0.3	1.0	0.2	0.9	2.6	3.3
Grease	57	37	63	67	98	85	86
COD	530	780	460	340	570	550	380
Chlorides (As NaCl)	580	520	360	720	340	320	390
Nitrate (as N)	1.0	0.3	2.0	2.6	3.1	4.7	2.5
Nitrite (As N)	0.10	0.22	0.07	0.03	0.30	0.17	0.14
Ammonia (as N)	16.7	17.0	20.8	19.1	18.4	16.9	16.4
Organic nitrogen (as N)	20.0	19.0	17.5	13.4	22.6	21.1	18.2
Total nitrogen (as N)	37.8	36.5	40.4	35.1	44.4	42.9	37.2
Total dissolved phosphate (as PO_4)	20	21	25	27	30	24	26
Total phosphorus (as PO_4)	24	34	36	30	32	32	31
Settleable matter, ml/l/hr	21.0	12.0	12.0	13.0	10.0	14.0	11.0
Settleable matter, mg/l/hr	130	130	140	74	150	70	180
Turbidity, JTU	75	61	62	51	65	67	53

Comments:

Reported by Morris Lifschutz

WATER ANALYSIS REPORT

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Analysis No.	11534	11542	11558	11564	11578	11587	11594
Source of Sample	NORTH POINT WATER POLLUTION CONTROL PLANT Grab Sample of Plant Effluent at Peak Flow						
	7/30	3/31	8/1	8/2	8/3	8/4	8/5
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total solids	800	800	750	770	720	730	760
Total volatile solids	200	500	210	220	250	260	390
Total suspended solids	85	110	100	59	110	110	90
Volatile suspended solids	73	91	98	48	100	99	74
Floatables	0.4	0.5	0.7	0.2	0.5	1.4	2.9
Grease	96	35	35	93	31	46	44
COD	-	370	320	290	430	400	310
Chlorides (As NaCl)	480	450	430	460	480	350	410
Nitrate (as N)	1.4	0.2	2.3	4.1	2.3	2.3	2.9
Nitrite (as N)	0.10	0.07	0.10	0.02	0.08	0.12	0.12
Ammonia	19.2	18.3	20.6	20.8	18.8	17.3	18.1
Organic nitrogen (as N)	16.7	13.7	16.2	11.4	14.6	16.8	15.3
Total nitrogen (as N)	37.4	32.3	39.2	36.3	35.8	36.5	36.4
Total dissolved phosphate (as PO_4)	16.0	19.0	22.5	23.0	22.0	20.5	20.0
Total phosphorous (as PO_4)	21.5	26.0	24.0	27.5	24.5	26.5	26.0
Settleable matter, ml/l/hr	0.5	0.6	0.6	0.1	0.4	0.1	0.6
Settleable matter, mg/l/hr	5	30	25	3	35	38	18
Turbidity, JTU	52	55	62	42	53	51	53

Comments: COD on Sample 11534 was overlooked.

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

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Report to Brown and Caldwell, Consulting Engineers Date Received 7/30 - 8/5/70

Copies to San Francisco Department of Public Works Date Reported 10/26/70

Analysis No.	11550	11556	11561	11574	11585	11592	11664
Source of Sample	NORTHPOINT WATER POLLUTION CONTROL PLANT Daily Composites of Raw Sludge to Southeast WPCP						
	7/30	7/31	8/1	8/2	8/3	8/4	8/5
DETERMINATION	%	%	%	%	%	%	%
Total solids	1.0	0.96	0.84	0.87	1.1	1.0	1.3
Volatile solids (% of total solids)	71	75	79	74	74	73	75
Grease (% of total solids)	21	13	7.9	3.8	14	18	45
COD	1.2	1.1	0.89	0.87	1.2	1.3	1.4
Chlorides (as NaCl)	0.12	0.15	0.18	0.15	0.14	0.17	0.15
Ammonia (as N)				0.0043		0.0062	
Organic nitrogen (as N)				0.028		0.025	
Total nitrogen (as N)				0.032		0.031	
Total phosphorus (as N)				0.016		0.021	
Values corrected for NaCl							
Total corrected solids	0.88	0.81	0.66	0.72	1.0	0.83	1.2
Volatile solids (% of total corrected solids)	81	89	100	89	81	88	81
Grease (% of total corrected solids)	24	15	10	4.5	15	22	49

Comments:

Reported by Morris Lifschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85, 284 Date Collected 7/30/70

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Copies to San Francisco Department of Public Works Date Reported 10/26/70

NORTH POINT WATER POLLUTION CONTROL PLANT

Grab Samples of Raw Sludge to Southeast Water Pollution Control Plant

Thursday, July 30, 1970

Analysis No.	Sampling time	Total solids (%)	Volatile solids (% of total solids)
11618	01:00	0.85	81
11630	02:00	3.3	88
11633	03:00	0.91	80
11615	04:00	0.55	66
11617	05:00	0.55	63
11614	06:00	0.89	67
11621	07:00	-	-
11613	08:00	1.7	71
11624	09:00	0.34	54
11616	10:00	0.49	72
11622	11:00	1.1	71
11619	12:00	1.7	78
11620	13:00	1.5	77
11623	14:00	1.3	72
11625	15:00	0.97	70
11627	16:00	0.77	65
11631	17:00	1.4	74
11635	18:00	2.2	76
11626	19:00	0.90	68
11628	20:00	0.82	74
11634	21:00	1.1	77
11636	22:00	0.53	72
11632	23:00	1.2	72
11629	24:00	0.78	61

Reported by Morris Lifschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85, 284 Date Collected 8/2 - 8/4/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/2 - 8/4/70

Copies to San Francisco Department of Public Works Date Reported 10/26/70

NORTH POINT WATER POLLUTION CONTROL PLANT

Determination of Raw Sludge Force Main Chlorine Demand

Chlorine demand time intervals	11561A Raw sludge 8/2 - 8:00 a.m. (grab sample) mg/1	11592A Raw sludge 8/4 - 8:00 a.m. (grab sample) mg/1
Initial	30	29
15 minutes		33
1/2 hour		36
1 hour	53	40
1-1/2 hours	53	
2 hours	64	40
2-1/2 hours	64	
2-3/4 hours		44
3 hours	64	
3-1/4 hours		51
3-1/2 hours	64	
3-3/4 hours		58
4 hours	64	62
4-1/2 hours	75	
4-3/4 hours		70
5 hours	80	
5-1/4 hours		73
5-1/2 hours	85	

Comments:

The test was run by treating a series of equal aliquots of sample with increasing amounts of a chlorine water solution of known concentration; the treated samples were allowed to stand with frequent shaking. At the indicated time intervals small portions of the treated samples were tested on a spot-plate with ortho-tolidine reagent. The chlorine demand for an indicated time was taken as the mid-point between two successive added chlorine concentrations, the lower of which showed no residual and the higher of which showed a residual. The tests were started immediately on receipt of the samples.

Reported by Morris Sipreshutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85, 284 Date Collected 7/30 - 8/5/7

Report to Brown and Caldwell, Consulting Engineers Date Received 7/31 - 8/6/7

Copies to San Francisco Department of Public Works Date Reported 10/26/70

NORTH POINT WATER POLLUTION CONTROL PLANT

Grit Flow to Washer

Analysis No.	Daily Composite	Total solids mg/l	Volatile solids mg/l
11546	7/30	1400	280
11554	7/31	1300	230
11562	8/1	1500	440
11576	8/2	1700	700
11582	8/3	1800	610
11591	8/4	1800	860
11604	8/5	1800	980

Grit Overflow from Washer

Analysis No.	Daily Composite	Total solids mg/l	Volatile solids mg/l
11544	7/30	1400	260
11555	7/31	1400	240
11563	8/1	1600	480
11575	8/2	1400	470
11581	8/3	1500	700
11590	8/4	1400	400
11605	8/5	1300	400

Reported by Morris Lipschultz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 10/15/70

Report to Mr. De La Fuente — Date Received 10/15/70

Copies to — Date Reported 10/23/70

Analysis No.	12093	12094		
Source of Sample	N. Point WPCP Grit out of Tank	North Point WPCP Grit out of Washer		
DETERMINATION	%	%		
Total Solids	61	68		
Volatile Solids	14	7.1		
Volatile Solids, as % of dry solids	35	23		

Comments:

Analyst J. Tyler

Reported by Morris Lipschuetz

Morris Lipschuetz

TESTING LABORATORIES

ABBOT A. HANKS

ESTABLISHED 1866

P. O. BOX 77265 • SAN FRANCISCO, CALIFORNIA 94107

TELEPHONE (415) 282-8600

BROWN & CALDWELL

Consulting Engineers

66 Mint Street

San Francisco, CA. 94103

LABORATORY REPORT

No. 18

Date October 27,1970

File No.

Lab No.	Mark	Results	
00524	Sample # 12094 for Sieve Analyses	Retained on No. 65 Mesh Sieve	55.0%
		Retained on No. 100 Mesh Sieve	36.7%
		Retained on No. 150 Mesh Sieve	6.9%
		Retained on No. 200 Mesh Sieve	0.7%
		Passing through No. 200 Mesh Sieve	0.7%
		TOTAL	100.0%

ABBOT A. HANKS

By M. H. Abed

sl

Allied Life Sciences, inc.

1935 Republic Avenue, San Leandro, California 94577 (415) 351-0493

Sept. 25, 1970

Mr. Warren Uhte
Brown & Caldwell
66 Mint Street
San Francisco, Calif.

Dear Mr. Uhte:

Following are the results of pesticide analysis done on twenty water samples received August 3, 1970 through August 7, 1970 from the North Point Sewage Treatment Plant.

The samples were analyzed for specific chlorinated hydrocarbons by use of the Varian 2100 Electron Gas Chromatograph.

All results given in parts per billion (ppb).

Explanation of abbreviations used in the report: Effluent composite - eff. comp.
Peak Flow - P.F.
Influent composite - inf. comp.

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1649 F	7/30 Inf. comp.	Lindane (L)	**
		Heptachlor-epoxide (HE)	<.01 *
		DDE	.06
		DDD	.14
		DDT	<.05 *
		Dieldrin (D)	.06
1649 D	7/30 Eff. comp.	L	.08
		HE	<.01 *
		DDE	.05
		DDD	.09
		DDT	.08
		D	.05
1649 I	7/31 Inf. comp.	L	.03
		HE	<.01 *
		DDE	.19
		DDD	.10
		DDT	<.05 *
		D	.14

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1649 E	7/31 Eff. comp.	L	.07
		HE	< .01 *
		DDE	.16
		DDD	.13
		DDT	< .05 *
		D	.10
1649 K	8/1 Inf. comp.	L	.13
		HE	< .01 *
		DDE	.18
		DDD	.16
		DDT	< .05 *
		D	.10
1649 A	8/1 Eff. comp.	L	.11
		HE	< .01 *
		DDE	.05
		DDD	.16
		DDT	< .05 *
		D	.09
1649 G	8/2 Inf. comp.	L	.09
		HE	< .01 *
		DDE	.08
		DDD	.08
		DDT	.14
		D	.11
1649 B	8/2 Eff. comp.	L	.09
		HE	< .01 *
		DDE	.18
		DDD	.09
		DDT	< .05 *
		D	.09
1649 J	8/2 Inf. ~~grab~~ P.F. grab	L	.26
		HE	< .01 *
		DDE	< .01 *
		DDD	.14
		DDT	.46
		D	.08
1649 C	8/2 Eff. P.F. grab	L	.16
		HE	< .01 *
		DDE	.04
		DDD	.08
		DDT	.50
		D	.07

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1649 H	8/2 Raw Sludge	L	1.70
		HE	< .05 *
		DDE	1.90
		DDD	6.00
		DDT	1.50
		D	2.40
1652 B	8/3 Inf. comp.	L	.13
		HE	<.01 *
		DDE	.17
		DDD	.13
		DDT	<.05 *
		D	.07
1652 A	8/3 Eff. comp.	L	.10
		HE	<.01 *
		DDE	.03
		DDD	.13
		DDT	<.05 *
		D	.11
1663 C	8/4 Inf. comp.	L	.19
		HE	.06
		DDE	.14
		DDD	.21
		DDT	.13
		D	.09
1663 A	8/4 Eff. comp.	L	.22
		HE	<.01 *
		DDE	.16
		DDD	.11
		DDT	.08
		D	.07
1658 B	8/4 Inf. P.F. grab	L	.08
		HE	<.01 *
		DDE	.07
		DDD	.11
		DDT	.25
		D	.05
1658 A	8/4 Eff. P.F. grab	L	.14
		HE	<.01 *
		DDE	.04
		DDD	.13
		DDT	.15
		D	.10

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1658 C	8/4 Raw Sludge	L	.72
		HE	< .05 *
		DDE	1.18
		DDD	4.39
		DDT	1.77
		D	3.25
1663 D	8/5 Inf. comp.	L	**
		HE	< .01 *
		DDE	.05
		DDD	.06
		DDT	< .05 *
		D	.07
1663 B	8/5 Eff. comp.	L	**
		HE	< .01 *
		DDE	.05
		DDD	.10
		DDT	< .05 *
		D	.05

* Limit of detection

** Unable to give value for Lindane due to high background level of sample

Sincerely,

Mary E. Nichols/cs

Mary E. Nichols
Chemist

METALLURGICAL LABORATORIES, INC. CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-8575

NORTH POINT

Spectrographic Analysis
(Semi-quantitative)

Weekly composite of daily composites

Submitted by Brown & Caldwell Laboratories
66 Mint Street
San Francisco, California 94103

Date August 31, 1970

Sample of Ashed Samples

P. O. No. 1342

Lab. No. 7247

SAMPLE MARK →	Influent 11665	Effluent 11666	Raw sludge 11682	SAMPLE MARK →	11665	11666	11682
IRON %	0.30	0.20	1.50	SODIUM %	Major	Major	Major
COPPER	0.02	0.02	0.20	POTASSIUM	2.00	1.00	3.00
NICKEL	0.002	0.010	0.010	STRONTIUM	0.05	0.05	0.05
CHROMIUM	0.01	0.02	0.06	ZIRCONIUM	0.003	0.003	0.006
ALUMINUM	1.50	2.00	3.00	BORON	0.10	0.10	0.10
LEAD	0.03	0.03	0.03	BARIUM	0.03	0.02	0.20
TIN	0.002	0.002	0.02	RARE EARTHS			
ZINC	0.04	0.03	Major	Antimony			0.02
COBALT *	0.001	0.001	0.001	Phosphorus ?	0.50	0.50	2.00
MANGANESE	0.02	0.01	0.04				
MOLYBDENUM	0.001*	0.001*	0.002				
SILICON	10.00	12.00	14.00				
SILVER	0.001	0.001	0.02				
VANADIUM	0.002	0.003	0.005				
MAGNESIUM	Major	Major	5.00				
CALCIUM	1.50	2.00	7.00				
TITANIUM	0.06	0.08	0.16				
[illegible]MUTH	0.001*	0.001*	0.002				

? Phosphorus lines questionable due to poor sensitivity.

*LESS THAN

**CHEMICAL DETERMINATION

METALLURGICAL LABORATORIES, INC.

By Martin P. Quist
SPECTROCHEMIST

256342

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers

Date Collected 7/30-8/5/70

Report to Mr. Warren Uhte

Date Received 7/31-8/6/70

Copies to

Date Reported 1/28/71

Analysis No.	11540	11553	11560	11573
Source of Sample	NP WPCP Effl. Comp. 7/30/70	NP WPCP Effl. Comp., 7/31/70	NP WPCP Effl. Comp. 8/1/70	NP WPCP Effl Comp. 8/2/70
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Lead as Pb by AAS	0.14	0.11	0.09	0.06
Aluminum as Al by AAS	0.9	0.4	0.5	0.6

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 7/30-8/5/70

Report to: Mr. Warren Uhte — Date Received: 7/31-8/6/70

Copies to: — Date Reported: 1/28/71

Analysis No.	11580	11589	11603	
Source of Sample	NP WPCP Effl. Comp. 8/3/70	NP WPCP Effl. Comp., 8/4/70	NP WPCP Effl. Comp. 8/5/70	
DETERMINATION	mg/l	mg/l	mg/l	
Lead as Pb by AAS	0.12	0.15	0.12	
Aluminum as Al by AAS	0.7	1.1	0.5	

Comments:

Analyst: S. Kirby

Reported by: Morris Lipschuetz
Morris Lipschuetz

WASTEWATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Anal. No. 11828

Report to: Mr. Warren Uhte — Date Collected: 7/30-8/5/70

Copies to: — Date Received: 7/31-8/6/70

Source of Sample: North Point WPCP- Weekly Composite of Daily Influent Composites — Date Reported: 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRA PER LIT
Nitrite (NO_2)	0.08	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	19
Nitrate (NO_3)	0.2	0.003	Methyl Orange Alkalinity ($CaCO_3$)	118	Nitrite (N)	
Chloride (Cl)	468	13.20	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.05
Sulfate (SO_4)	91	1.89	Calcium Hardness ($CaCO_3$)	65	Ammonia (N)	15
Bicarbonate (HCO_3)	137	2.25	Magnesium Hardness ($CaCO_3$)	165	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	230	Total Nitrogen (N)	
H. Phosphate (HPO_4)	12	0.25	Dissolved Residue - Calculated	1284	Boron (B)	
H_2Phosphate (H_2PO_4)	2	0.02	Dissolved Residue - Evaporated	1176	Fluoride (F)	1.4
Total Milliequivalents per Liter		17.35	Loss on Ignition		Total Phosphate (PO_4)	14
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	16	0.88	Suspended Matter, total		M B A S	
Sodium (Na)	285	12.40	Suspended Matter, volatile		Grease	
Potassium (K)	19	0.49				
Calcium (Ca)	26	1.30	Sp. Cond. - Micromhos 25°C	1960		
Magnesium (Mg)	40	3.29	Hydrogen Ion Concentration (pH)	7.6		
Total Milliequivalents per Liter		18.36	Sodium Percent			

Comments: Sample preserved with chloroform.

Analyst: A. Jeong, J. Tyler, S. Kirby

Reported by: Morris Lipschuetz

Morris Lipschuetz

WASTEWATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Anal. No. 11827

Report to Mr. Warren Uhte — Date Collected 7/30-8/5/70

Copies to — Date Received 7/31-8/6/70

Source of Sample North Point WPCP Comp. of Daily Effluent Composites — Date Reported 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.07	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	10
Nitrate (NO_3)	0.2	0.003	Methyl Orange Alkalinity ($CaCO_3$)	130	Nitrite (N)	
Chloride (Cl)	488	13.76	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.05
Sulfate (SO_4)	92	1.91	Calcium Hardness ($CaCO_3$)	74	Ammonia (N)	16
Bicarbonate (HCO_3)	151	2.48	Magnesium Hardness ($CaCO_3$)	137	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	211	Total Nitrogen (N)	
H. Phosphate (HPO_4)	11	0.23	Dissolved Residue - Calculated	1082	Boron (B)	
H_2Phosphate (H_2PO_4)	1	0.01	Dissolved Residue - Evaporated	1192	Fluoride (F)	1.1
Total Milliequivalents per Liter		18.40	Loss on Ignition		Total Phosphate (PO_4)	12
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	17	0.94	Suspended Matter, total		M B A S	
Sodium (Na)	297	12.92	Suspended Matter, volatile		Grease	
Potassium (K)	24	0.61				
Calcium (Ca)	30	1.50	Sp. Cond. - Micromhos 25°C	2030		
Magnesium (Mg)	33	2.71	Hydrogen Ion Concentration (pH)	7.7		
Total Milliequivalents per Liter		18.68	Sodium Percent			

Comments:

Samples preserved with chloroform.

Analyst A. Jeong, J. Tyler, S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

BROWN AND CALDWELL LABORATORIES 66 MINT STREET, SAN FRANCISCO, CALIFORNIA, 94103 • Tel: (415) 982-2442

BCL-14

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/13/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

	70795	70796	70797	70798
LAB NO.	70795	70796	70797	70798
SOURCE OF SAMPLE: North Point	Sludge to S.E.	Sludge to S.E.	Sludge to S.E.	Sludge to S.E.
TREATMENT:				
DATE COLLECTED:	7/30/70	7/31/70	8/1/70	8/2/70
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	0000-2400

ANALYTICAL RESULTS

Analysis	Units				
SULFIDES	Mg/L	14	20	6	6

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

SD Analyst

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/13/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70799	70800	70801	70802
SOURCE OF SAMPLE: North Point		Sludge to S.E.	Sludge to S.E.	Sludge to S.E.	Pump Discharge Flow through ~~plant~~
TREATMENT:					
DATE COLLECTED:		8/3/70	8/4/70	8/5/70	8/5/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	34	10	68	0.2

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/13/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70803	70804	70805	70806
SOURCE OF SAMPLE: North Point		Pump Sump	Grit Channel	Sed. Tank Effluent	End of Preartor
		----Flow through plant----			
TREATMENT:					
DATE COLLECTED:		8/5/70	8/5/70	8/5/70	8/5/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400
Analysis	**Units**	**ANALYTICAL RESULTS**			
SULFIDES	Mg/L	0.1	0.2	0.1	0.1

COMMENTS:

S.D. Analyst

R. A. Ryder Director

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/13/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70788	70789	70790	
SOURCE OF SAMPLE: Southeast WPCP		Sludge at S.E.	Sludge at S.E.	Sludge at S.E.	
TREATMENT:					
DATE COLLECTED:		7/30/70	7/31/70	8/1/70	
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES		40	36	44	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/13/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70791	70792	70793	70794
SOURCE OF SAMPLE: Southeast WPCP		Sludge at S.E.	Sludge at S.E.	Sludge at S.E.	Sludge at S.E.
TREATMENT:					
DATE COLLECTED:		8/2/70	8/3/70	8/4/70	8/5/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	50	32	46	20

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 7/31-8/1/70

Reported 8/14/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR Brown and Caldwell Laboratories REPORT TO Mr. Morris Lipschuetz

ADDRESS 66 Mint Street, San Francisco, California

LAB NO.	70733	70734	70735	70736
SOURCE OF SAMPLE:	North Point Plant Inf.	North Point Plant Eff.	North Point Plant Inf.	North Point Plant Eff.
DATE COLLECTED:	7/30/70	7/30/70	7/31/70	7/31/70
TIME COLLECTED:	0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aqu.-Filtered Sea Water
Number of Fish per Concentration 10
Test Fish Threespine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20±0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.8	7.6	7.7	7.4
tal Alkalinity ($CaCO_3$)	MG/L	120	110	124	115
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	6.7	5.5	5.7	5.2
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24hrs.)	%	10	10	50	50
Survival in Undiluted Wastewater (48hrs.)	%	10	10	20	0
Survival in Undiluted Wastewater (96hrs.)	%	0	0	0	0
Median Tolerance Limit (TL_m^{24})	%	82	82	100	100
Median Tolerance Limit (TL_m^{48})	%	69	82	79	77
Median Tolerance Limit (TL_m^{96})	%	68	80	68	72

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/2/70

Reported 8/14/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR Brown and Caldwell Laboratories REPORT TO Mr. Morris Lipschuetz

ADDRESS 66 Mint Street, San Francisco, California

LAB NO.		70737	70738	70739	70740
SOURCE OF SAMPLE:		North Point Plant Inf.	North Point Plant Eff.	North Point Plant Inf.	North Point Plant Eff.
DATE COLLECTED:		8/1/70	8/1/70	8/2/70	8/2/70
TIME COLLECTED:		0000-2400	0000-2400	Peak Flow Grab	Peak Flow Grab

Source of Dilution Water Steinhart Aqu.-Filtered Sea Water
Number of Fish per Concentration 10
Test Fish Threespine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20±0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.5	7.8	7.8	8.0
tal Alkalinity ($CaCO_3$)	MG/L	118	106	125	127
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	5.8	7.2	7.0	8.2
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24hrs.)	%	0	0	0	0
Survival in Undiluted Wastewater (48hrs.)	%	0	0	0	0
Survival in Undiluted Wastewater (96hrs.)	%	0	0	0	0
Median Tolerance Limit (TL_m^{24})	%	68	72	68	63
Median Tolerance Limit (TL_m^{48})	%	68	68	63	50
Median Tolerance Limit (TL_m^{96})	%	47	68	63	32

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/3-4/70

Reported 8/14/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR Brown and Caldwell Laboratories REPORT TO Mr. Morris Lipschuetz

ADDRESS 66 Mint Street, San Francisco, California

LAB NO.		70741	70743	70744	70745
SOURCE OF SAMPLE:		North Point Plant Inf.	North Point Plant Eff.	North Point Plant Inf.	North Point Plant Eff.
DATE COLLECTED:		8/2/70	8/2/70	8/3/70	8/3/70
TIME COLLECTED:		0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aqu.-Filtered Sea Water
Number of Fish per Concentration 10
Test Fish Threespine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20±0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	8.1	7.8	7.9	7.9
.al Alkalinity ($CaCO_3$)	MG/L	114	105	114	105
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	7.7	6.7	7.2	7.8
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24hrs.)	%	0	0	90	90
Survival in Undiluted Wastewater (48hrs.)	%	0	0	90	70
Survival in Undiluted Wastewater (96hrs.)	%	0	0	30	70
Median Tolerance Limit (TL_m^{24})	%	72	68	>100	>100
Median Tolerance Limit (TL_m^{48})	%	68	56	>100	>100
Median Tolerance Limit (TL_m^{96})	%	68	50	88	100

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

R. A. Ryder

#4

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/4-5/70

Reported 8/14/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR Brown and Caldwell Laboratories REPORT TO Mr. Morris Lipschuetz

ADDRESS 66 Mint Street, San Francisco, California

LAB NO.		70745	70746	70747	70748
SOURCE OF SAMPLE:		North Point Plant Inf.	North Point Plant Eff.	North Point Plant Inf.	North Point Plant Eff.
DATE COLLECTED:		8/3/70	8/3/70	8/4/70	8/4/70
TIME COLLECTED:		Peak Flow Grab	Peak Flow Grab	0000-2400	0000-2400

Source of Dilution Water Steinhart Aqu.-Filtered Sea Water
Number of Fish per Concentration 10

Test Fish Threespine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20±0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.9	7.7	7.5	7.6
[illegible]al Alkalinity ($CaCO_3$)	MG/L	160	134	139	116
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	7.2	7.7	7.4	7.2
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24hrs.)	%	90	90	100	100
Survival in Undiluted Wastewater (48hrs.)	%	0	60	100	100
Survival in Undiluted Wastewater (96hrs.)	%	0	40	80	90
Median Tolerance Limit (TL_m^{24})	%	>100	>100	>100	>100
Median Tolerance Limit (TL_m^{48})	%	75	>100	>100	>100
Median Tolerance Limit (TL_m^{96})	%	72	92	>100	>100

COMMENTS:

G.N. Analyst

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received	8/6/70
Reported	8/14/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR Brown and Caldwell Laboratories REPORT TO Mr. Morris Lipschuetz

ADDRESS 66 Mint Street, San Francisco, California

LAB NO.	70749	70750		
SOURCE OF SAMPLE:	North Point Plant Inf.	North Point Plant Eff.		
DATE COLLECTED:	8/5/70	8/5/70		
TIME COLLECTED:	0000-2400	0000-2400		

Source of Dilution Water Steinhart Aqu.-Filtered Sea Water
Number of Fish per Concentration 10
Test Fish Threespine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 o.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	8.2	8.1		
al Alkalinity ($CaCO_3$)	MG/L	146	125		
Residual Chlorine	MG/L	---	<0.1		
Dissolved Oxygen	MG/L	8.2	8.4		
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24hrs.)	%	90	100		
Survival in Undiluted Wastewater (48hrs.)	%	70	90		
Survival in Undiluted Wastewater (96hrs.)	%	40	40		
Median Tolerance Limit (TL_m^{24})	%	>100	>100		
Median Tolerance Limit (TL_m^{48})	%	>100	>100		
Median Tolerance Limit (TL_m^{96})	%	91	93		

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

R. A. Ryder

APPENDIX C-2

RICHMOND-SUNSET LABORATORY DATA SHEETS

TABLE OF CONTENTS

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Study - DPW 85,284 | Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers | Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works | Date Reported 10/28/70

Analysis No.	11691	11700	11713	11721	11729	11737	11748
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Daily Composites of Plant Influent						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total solids	680	600	670	870	690	730	670
Total volatile solids	370	320	420	410	350	450	440
Total suspended solids	360	270	330	320	280	270	400
Volatile suspended solids	350	270	330	320	280	270	390
Floatables	4.2	1.7	2.2	3.0	5.2	2.5	2.7
Grease	58	53	53	71	60	37	60
5-Day BOD, 20°C	160	180	230	230	150	-	130
COD	460	470	520	530	440	460	550
Chlorides (as NaCl)	290	200	230	390	270	270	230
Nitrate (as N)	0.5	0.6	0.8	0.9	0.5	1.2	0.1
Nitrite (as N)	0.04	0.03	0.03	0.03	0.02	0.03	0.03
Ammonia (as N)	23.0	12.0	22.2	23.4	20.3	20.7	22.3
Organic nitrogen (as N)	12.3	16.1	17.1	13.4	15.5	14.2	21.7
Total nitrogen (as N)	35.8	28.7	40.1	37.7	36.3	36.1	44.0
Total dissolved phosphate (as PO_4)	19	23	24	32	34	35	18
Total phosphorus (as PO_4)	38	33	35	38	38	36	30
Settleable matter, ml/l/hr	8.0	10	24	18	13	13	15
Settleable matter, mg/l/hr	270	170	240	230	190	260	370
Turbidity, JTU	55	50	51	54	49	43	42

Comments: Turbidity measurements made after 1 hour settling in the laboratory. The BOD result for Analysis No. 11737 was of doubtful validity and is not reported.

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85, 284 Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/12 - 8/18/7

Copies to San Francisco Department of Public Works Date Reported 10/28/70

Analysis No.	11683	11694	11711	11719	11726	11735	11746
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Grab Sample of Plant Influent at Peak Flow						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total suspended solids	270	300	310	390	310	360	290
Volatile suspended solids	270	300	310	350	300	320	250
Floatables	1.9	1.8	1.4	3.9	3.6	1.7	3.8
Grease	60	64	92	72	62	64	70
COD	520	530	440	570	350	380	420
Nitrate (as N)	2.0	0.3	1.7	1.3	1.7	0.4	0.3
Nitrite (as N)	1.3	0.01	0.04	0.86	0.03	0.10	0.02
Ammonia (as N)	24.6	22.5	22.1	33.6	32.0	23.7	25.8
Organic nitrogen (as N)	20.1	14.4	15.0	11.7	19.9	24.9	23.4
Total nitrogen (as N)	48.0	37.2	38.8	47.5	53.6	49.1	49.5
Total dissolved phosphate (as PO_4)	22	24	33	38	34	44	37
Total phosphorus (as PO_4)	44	44	47	42	32	32	60
Settleable matter, ml/l/hr	20	21	13	14	13	12	13
Settleable matter, mg/l/hr	160	180	110	270	190	180	280
Turbidity, JTU	57	52	53	62	55	62	55

Comments:

Reported by Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works Date Reported

Analysis No.	11692	11701	11714	11722	11730	11738	11749
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Daily Composites of Plant Effluent						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
otal solids	570	520	470	700	610	580	510
otal volatile solids	310	200	290	310	330	300	310
otal suspended solids	160	150	100	90	130	-	140
olatile suspended solids	150	150	100	90	130	-	130
loatables	1.9	0.9	2.8	2.0	3.2	3.0	2.6
rease	42	44	31	47	59	44	37
-Day BOD, 20°C	160	140	120	98	90	-	79
OD	340	310	330	360	280	320	-
hlorides (as NaCl)	240	210	190	370	210	280	220
itrate (as N)	0.4	0.5	0.4	0.7	0.2	0.7	-
itrite (as N)	0.02	0.02	0.02	0.02	0.02	0.02	-
mmonia (as N)	24.4	12.2	23.4	23.6	23.6	27.2	-
rganic nitrogen (as N)	10.0	12.0	9.7	14.5	19.1	12.9	-
otal nitrogen (as N)	34.6	24.7	33.5	38.8	42.9	40.0	-
otal dissolved phosphate (as PO_4)	22	24	28	31	30	35	-
otal phosphorus (as PO_4)	38	35	38	36	45	39	-
ettleable matter, ml/l/hr	2.5	0.9	0.2	0.5	0.05	0.05	0.05
ettleable matter, mg/l/hr	33	95	45	35	69	-	90
urbidity, JTU	57	52	53	57	54	52	52

Comments:

Analyst Reported by Morris Lipschutz

Richmond-Sunset Water Pollution Control Plant
Daily Composites of Plant Effluent

Comments:

The BOD value for Analysis No. 11738 was very high and is of questionable validity; the result is not reported.

The results for the forms of nitrogen and phosphorus and COD on Analysis No. 11749 were very high and are not reported. The physical appearance of the sample (preserved with mercury chloride) was markedly different from the appearance of the other daily composite samples and it is likely that there was a sampling error.

The results for suspended solids and for settleable matter by weight on Analysis No. 11738 are of doubtful validity and are not reported.

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WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works — Date Reported 10/28/70

Analysis No.	11684	11695	11712	11720	11727	11736	11747
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Grab Sample of Plant Effluent at Peak Flow						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total suspended solids	-	130	160	140	100	180	130
Volatile suspended solids	-	130	160	140	100	160	110
Floatables	1.9	1.0	1.1	3.0	3.1	2.7	5.4
Grease	39	40	39	53	27	43	47
COD	380	330	330	350	260	180	270
Nitrate (as N)	1.0		1.0	1.9	0.2	1.6	0.4
Nitrite (as N)	0.02		0.02	0.03	0.02	0.02	0.02
Ammonia (as N)	26.0		26.4	30.5	23.6	28.4	28.6
Organic nitrogen (as N)	20.7		12.0	14.7	19.1	12.6	21.3
Total nitrogen (as N)	47.7		39.4	47.1	42.9	42.2	50.3
Total dissolved phosphate (as PO_4)	24		29	38	30	35	23
Total phosphorus (As PO_4)	38		36	40	30	38	36
Settleable matter, ml/l/hr	0.5	0.1	0.2	0.7	0.3	0.5	0.2
Settleable matter, mg/l/hr	32	27	75	46	46	93	88
Turbidity, JTU	54	51	50	57	52	50	54

Comments: Analysis No. 1195 was accidently discarded before nutrients were determined.

Analysis No. 11684 data for suspended solids of questionable validity and not reported.

Reported by Morris Wysocki

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/12 - 8/18/7

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works — Date Reported 10/28/70

Analysis No.	11696	11704	11717	11725	11734	11743	11759
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Raw Sludge to Digester from Thickening Tanks						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	%	%	%	%	%	%	%
Total solids	2.0	1.8	1.7	1.6	1.8	2.0	1.5
Volatile solids (% of total solids)	83	86	82	83	61	85	86
Grease, (% of total solids)	25	31	15	-	-	16	26
COD	2.6	2.4	1.7	2.3	1.4	1.2	2.4
Chlorides (As NaCl)	0.05	0.02	0.05	0.03	0.05	0.05	0.05
Ammonia (As N)					0.0046		0.0029
Organic nitrogen (as N)					0.056		-
Total nitrogen (as N)					0.060		
Total phosphorus (as PO_4)					0.047		-

Comments:

Samples 11725 and 11734 deteriorated and were discarded before the grease could be determined. Samples 11759 and 11772 had been discarded before the analyses could be completed.

Reported by Morris Lipschultz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works Date Reported 10/28/70

Analysis No.	11688	11703	11716	11724	11733	11744	11760
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Supernatant from Thickening Tanks to Sed. Tank Influent						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	%	%	%	%	%	%	%
otal solids	0.18	0.066	0.061	0.11	0.10	0.10	0.10
olatile solids (% of total solids)	78	84	78	63	81	82	85
rease (% of total solids)	13	5.5	14	10	13	14	15
hlorides (as NaCl)	0.02	0.02	-	-	-	-	-

Comments:

Samples 11716, 11724, 11733, 11744, and 11760 deteriorated and were discarded before chlorides could be determined.

Reported by Morris Liberchutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works — Date Reported 10/28/70

Analysis No.	11698	11705	11718	11728	11732	11745	11761
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT DIGESTED SUPERNATANT AND SLUDGE TO ELUTRIATION SYSTEM						
	8/12	8/13	8/14	8/15	8/16	8/17	8/18
DETERMINATION	%	%	%	%	%	%	%
Total solids	0.91	0.21	1.1	0.49	0.18	0.27	0.29
Volatile solids (% of total solids)	59	62	58	58	62	54	61
Grease (% of total solids)	6.9	4.0	22	8.2	10	6.5	-
Chlorides (as NaCl)	0.02	0.01	-	0.01	0.02	-	-
Values corrected for NaCl							
Total corrected solids	0.89	0.20	-	0.48	0.16	-	-
Volatile solids (% of total solids)	60	65	-	59	70	-	-
Grease, % of total solids	7.1	4.2	-	8.4	11	-	-
Alaklinity of supernatant (as $CaCO_3$), mg/l	1710	1760	1720	1700	1490	1180	1420

Comments: Samples 11718, 11745, and 11761 were discarded before chlorides (and grease on 11761) could be determined.

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works — Date Reported 10/28/70

Analysis No.	11690	11702	11715	11723	11731	11739	11750	11785
Source of Sample	RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT Daily Composites of Elutriation Overflow							
	8/12	8/13	8/14	8/15	8/16	8/17	8/18	
DETERMINATION	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	
otal solids	1320	980	1230	1310	1200	1230	1200	
otal volatile solids	920	620	770	800	730	800	880	
otal suspended solids	920	850	780	1140	660	690	790	
olatile suspended solids	770	770	710	1030	560	670	780	
loatables	3.8	3.0	4.3	2.5	4.3	5.9	3.2	
rease	72	9	64	120	100	180	98	
-Day BOD, 20°C	630	240	220	124	230	670	-	
OD	1400	1300	1200	970	1100	1100	-	
hlorides (as NaCl)	310	250	240	260	290	180	210	
itrate (as N)	-	-	-	-	-	-	-	
itrite (as N)	-	-	-	-	-	-	-	
mmonia (as N)	168	161	141	189	134	212	-	
rganic nitrogen (as N)	47.3	106	76.7	61.3	70.4	28.9	-	
otal nitrogen (as N)	215	267	219	250	204	241	-	
otal dissolved phosphate (as PO_4)	104	70	71	112	81	124	-	
otal phosphorus (as PO_4)	130	120	94	170	120	-	-	
ettleable matter, ml/1/hr	2.0	2.0	4.2	1.5	1.8	0.9	3.0	
ettleable matter, mg/1/hr	260	460	330	580	110	240	480	
urbidity, JTU	-	-	-	-	-	-	-	

Comments:

Analyst ______ Reported by Morris Lipschutz

Richmond-Sunset Water Pollution Control Plant
Daily Composites of Elutriation Overflow

Comments:

Nitrates and nitrties were not run because of the interferences due to color and turbidity.

Turbidity on laboratory-settled (hour) samples could not be measured.

The results for the forms of nitrogen and phosphorus and COD on Analysis No. 11750 (preserved with mercuric chloride) were low, and are not reported. The appearance of the sample was markedly different from that of the other daily composite samples and it is likely that there was a sampling error.

The total phosphorus result for Analysis No. 11739 is of doubtful validity and is not reported.

The BOD result for Analysis No. 11750 is of doubtful validity and is not reported.

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/12 - 8/18/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/12 - 8/18/70

Copies to San Francisco Department of Public Works — Date Reported 10/28/70

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

Daily Composites of Sludge Filter Cake

Analysis No.	11693	11706	11742	11758
Date	Wednesday August 12	Thursday August 13	Monday August 17	Tuesday August 18
Determination				
Total solids, %	24	26	28	26
Total volatile solids, % of total solids	58	58	57	58
Grease, % of total solids	4.2	7.3	2.4	12
Moisture, %	76	74	72	74

Analyst ______ Reported by Morris Sifrchust

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/12 - 8/18/

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/12 - 8/18/7

Copies to San Francisco Department of Public Works — Date Reported 10/28/70

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

Daily Composites of Filter Filtrate

Analysis No.	11697	11707	11740	11751
Date	Wednesday August 12	Thursday August 13	Monday August 17	Tuesday August 18
Determination				
Total solids, mg/l	1210	685	795	1360
Total volatile solids, mg/l	780	520	630	900
Grease, mg/l	6	2	12	2
Chlorides, mg/l (as NaCl)	-	-	-	-
Total iron, mg/l (as Fe)	110	42	88	150

Comments:

Samples deteriorated and were discarded before chlorides could be determined.

Reported by Morris Lipschutz

RECEIVED
BROWN & CALDWELL
OCT 12 1970
File.

Allied Life Sciences, inc.

1935 Republic Avenue, San Leandro, California 94577 (415) 351-0493

October 9, 1970

Mr. Warren Uhte
Brown & Caldwell
66 Mint Street
San Francisco, Calif.

Dear Mr. Uhte:

Following are the results of pesticide analysis done on seventeen water samples received August 13, 1970 through August 19, 1970 from the Richmond-Sunset Sewage Treatment Plant.

The samples were analyzed for specific chlorinated hydrocarbons by use of the Varian 2100 Electron Gas Chromatograph.

All results given in parts per billion (ppb).

Explanation of abbreviations usdd in this report:

Effluent	-	Eff.
Peak Flow	-	P.F.
Influent	-	Inf.

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1682 A	8/12 Inf.	Lindane (L)	.10
		Heptachlor-epoxide (HE)	<.01 *
		DDE	.18
		DDD	.05
		DDT	.09
		Dieldrin (D)	.51
1682 B	8/12 Eff.	L	.17
		HE	<.01 *
		DDE	.18
		DDD	.05
		DDT	.21
		D	.40
1686 A	8/13 Inf.	L	.15
		HE	.07
		DDE	.24
		DDD	.11
		DDT	.24
		D	.21

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1686 B	8/13 Eff.	L.	.13
		HE	<.01 *
		DDE	.05
		DDD	.13
		DDT	.03
		D	.14
1691 A	8/14 Inf.	L	.15
		HE	.06
		DDE	.07
		DDD	.08
		DDT	.24
		D	.11
1691 B	8/14 Eff.	L	.15
		HE	<.01 *
		DDE	.06
		DDD	.13
		DDT	.15
		D	.08
1691 C	8/15 Inf.	L	.12
		HE	<.01 *
		DDE	.01
		DDD	.02
		DDT	<.05 *
		D	.15
1691 D	8/15 Eff.	L	.07
		HE	<.01 *
		DDE	.02
		DDD	.05
		DDT	<.05 *
		D	.09
1691 E	8/16 Inf.	L	.14
		HE	<.01 *
		DDE	.09
		DDD	.05
		DDT	.13
		D	.25
1691 F	8/16 Eff.	L	.27
		HE	<.01 *
		DDE	.05
		DDD	.05
		DDT	.11
		D	.14

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1691 G	8/16 P.F. Inf.	L	.10
		HE	<.01 *
		DDE	.03
		DDD	.11
		DDT	.35
		D	.33
1691 H	8/16 P.F. Eff.	L	.11
		HE	<.01 *
		DDE	.02
		DDD	.06
		DDT	.30
		D	.17
1694 A	8/17 Inf.	L	.12
		HE	<.01 *
		DDE	.02
		DDD	.19
		DDT	.06
		D	.10
1694 B	8/17 Eff.	L	.13
		HE	<.01 *
		DDE	.15
		DDD	.06
		DDT	<.05 *
		D	.03
1699 A	8/18 Inf.	L	.09
		HE	<.01 *
		DDE	.05
		DDD	.12
		DDT	.10
		D	.21
1699 B	8/18/ Eff.	L	.08
		HE	<.01 *
		DDE	.01
		DDD	.05
		DDT	.06
		D	.14
1699 C	8/18 P.F.	L	.10
		HE	<.01 *
		DDE	.05
		DDD	.09
		DDT	.26
		D	.20

Note: 1699 C not labeled Influent or Effluent

* Limit of detection

Samples were not labeled composite

Sincerely,

Mary E Nichols /US

Mary E. (Smith) Nichols
Chemist

METALLURGICAL LABORATORIES, INC. CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-8575

Richmond-Sunset

Spectrographic Analysis

(Semi-quantitative)

Weekly Composite of Daily Composites

Submitted by Brown and Caldwell Laboratories
66 Mint Street
San Francisco, California 94103

Date August 31, 1970

Sample of Ash Samples

P. O. No. 1345

Lab. No. 7302

SAMPLE MARK →	Influent 11763	Effluent 11764	Elutriator Overflow 11765	SAMPLE MARK →	11763	11764	11765
IRON %	0.50	0.30	2.00	SODIUM %	Major	Major	6.00
COPPER	0.03	0.02	0.15	POTASSIUM	4.00	4.00	3.00
NICKEL	0.002	0.001	0.01	STRONTIUM	0.03	0.03	0.04
CHROMIUM	0.02	0.01	0.04	ZIRCONIUM	0.001*	0.001*	0.003
ALUMINUM	0.30	0.20	1.50	BORON	0.02	0.02	0.04
LEAD	0.005	0.005	0.15	BARIUM	0.20	0.01	0.50
TIN	0.01	0.002	0.03	RARE EARTHS			
ZINC	0.03	0.01*	0.30	Phosphorus	3.00	2.00	Major
COBALT *	0.001	0.001	0.001				
MANGANESE	0.01	0.01	0.04	Cd by AAS (mg/l)	0.02	0.03	
MOLYBDENUM							
SILICON	5.00	3.00	15.00				
SILVER	0.002	0.001	0.01				
VANADIUM	0.001*	0.001*	0.002				
MAGNESIUM	4.00	3.00	10.00				
CALCIUM	5.00	6.00	Major				
TITANIUM	0.08	0.06	0.15				
BISMUTH	0.001*	0.001*	0.003				

*LESS THAN

**CHEMICAL DETERMINATION

256342

METALLURGICAL LABORATORIES, INC.

By ______ SPECTROCHEMIST

METALLURGICAL LABORATORIES, INC.

CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-8575

RICHMOND SUNSET

Spectrographic Analysis
(Semi-quantitative)

Weekly Composite of Daily Composites

Submitted by Brown and Caldwell Laboratories
66 Mint Street
San Francisco, California 94103

Date August 31, 1970

Sample of Ash Samples

P. O. No. 1345

Lab. No. 7302

SAMPLE MARK →	Raw Sludge 11767 to Digester			SAMPLE MARK →	11767		
IRON %	2.00			SODIUM %	3.00		
COPPER	0.15			POTASSIUM	2.00		
NICKEL	0.005			STRONTIUM	0.04		
CHROMIUM	0.03			ZIRCONIUM	0.005		
ALUMINUM	3.00			BORON	0.01		
LEAD	0.10			BARIUM	0.50		
TIN	0.03			RARE EARTHS			
ZINC	3.00			Phosphorus	5.00		
COBALT	0.001						
MANGANESE	0.03						
MOLYBDENUM							
SILICON	Major						
SILVER	0.02						
VANADIUM	0.002						
MAGNESIUM	2.00						
CALCIUM	10.00						
TITANIUM	0.20						
BISMUTH	0.003						

*LESS THAN

**CHEMICAL DETERMINATION

METALLURGICAL LABORATORIES, INC.

By [signature]
SPECTROCHEMIST

256342

METALLURGICAL LABORATORIES, INC. CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-8575

Richmond Sunset

Spectrographic Analysis

(Semi-quantitative)

Weekly Composite of Daily Composites

Submitted by Brown & Caldwell
66 Mint Street
San Francisco, California

Date December 8, 1970

Sample of Products

P. O. No. 6562

Lab. No. 7719

SAMPLE MARK →	Peak flow effluent 11727 8/16	Daily composite effluent 11730 8/16	Peak flow effluent 11747 8/18	SAMPLE MARK →	11727	11730	11747
IRON %	0.10	0.10	0.20	SODIUM %	Major	Major	Major
COPPER	0.02	0.02	0.02	POTASSIUM	2.00	3.00	2.00
NICKEL	0.0005 *	0.0006	0.0006	STRONTIUM	0.04	0.04	0.06
CHROMIUM	0.002	0.002	0.003	ZIRCONIUM			
ALUMINUM	0.10	0.08	0.13	BORON	0.02	0.02	0.02
LEAD	0.002	0.001	0.003	BARIUM	0.05 *	0.05 *	0.15
TIN *	0.001	0.001	0.001	RARE EARTHS			
ZINC	0.01 *	0.01 *	0.02	Phosphorus	2.00	2.00	4.00
COBALT							
MANGANESE	0.01	0.01	0.01				
MOLYBDENUM							
SILICON	2.00	1.50	2.50				
SILVER	0.002	0.0001	0.0002				
VANADIUM							
MAGNESIUM	Major	Major	Major				
CALCIUM	4.00	3.00	5.00				
TITANIUM	0.001	0.003	0.002				
BISMUTH							

*LESS THAN

**CHEMICAL DETERMINATION

METALLURGICAL LABORATORIES, INC.

By Robert A Atwood

SPECTROCHEMIST

METALLURGICAL LABORATORIES, INC. | CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-

Richmond Sunset

Spectrographic Analysis
(Semi-quantitative)

Weekly composite of daily composites

Submitted by Brown & Caldwell
66 Mint Street
San Francisco, California

Date December 8, 1970

Sample of Products

P. O. No. 6562

Lab. No. 7719

SAMPLE MARK →	Daily composite effluent 11749 8/18			SAMPLE MARK →	11749		
IRON %	0.20			SODIUM %	Major		
COPPER	0.02			POTASSIUM	1.70		
NICKEL *	0.0005			STRONTIUM	0.06		
CHROMIUM	0.002			ZIRCONIUM			
ALUMINUM	0.10			BORON	0.02		
LEAD	0.003			BARIUM	0.10		
TIN *	0.001			RARE EARTHS			
ZINC	0.03			Phosphorus	3.00		
COBALT							
MANGANESE	0.01						
MOLYBDENUM							
SILICON	2.00						
SILVER	0.0002						
VANADIUM							
MAGNESIUM	Major						
CALCIUM	5.00						
TITANIUM	0.002						
BISMUTH							

*LESS THAN

**CHEMICAL DETERMINATION

METALLURGICAL LABORATORIES, INC.

By [signature]
SPECTROCHEMIST

WASTEWATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Anal. No. 11829

Report to: Mr. Warren Uhte — Date Collected: 8/12-18/70

Copies to: — Date Received: 8/13-19/70

Source of Sample: Richmond-Sunset WPCP- Weekly Composite of Daily Influent Composites — Date Reported: 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.03	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	19
Nitrate (NO_3)	1	0.02	Methyl Orange Alkalinity ($CaCO_3$)	154	Nitrite (N)	
Chloride (Cl)	214	6.03	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.23
Sulfate (SO_4)	26	0.54	Calcium Hardness ($CaCO_3$)	50	Ammonia (N)	27
Bicarbonate (HCO_3)	174	2.86	Magnesium Hardness ($CaCO_3$)	49	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	99	Total Nitrogen (N)	
H. Phosphate (HPO_4)	22	0.46	Dissolved Residue - Calculated	530	Boron (B)	
H_2Phosphate (H_2PO_4)	4	0.04	Dissolved Residue - Evaporated	504	Fluoride (F)	0.8
Total Milliequivalents per Liter		9.96	Loss on Ignition		Total Phosphate (PO_4)	26
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	29	1.60	Suspended Matter, total		M B A S	
Sodium (Na)	107	4.65	Suspended Matter, volatile		Grease	
Potassium (K)	13	0.33				
Calcium (Ca)	20	1.00	Sp. Cond. - Micromhos 25°C	965		
Magnesium (Mg)	12	0.99	Hydrogen Ion Concentration (pH)	7.5		
Total Milliequivalents per Liter		8.57	Sodium Percent			

Comments: Sample preserved with chloroform.

Analyst: A. Jeong, J. Tyler, S. Kirby

Reported by: Morris Lipschuetz

Morris Lipschuetz

WASTEWATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Anal. No. 11830

Report to Mr. Warren Uhte — Date Collected 8/12-18/70

Copies to — Date Received 8/13-19/70

Source of Sample Richmond-Sunset WPCP- Weekly Composite of Daily Effluent Composites — Date Reported 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.07	0.01	Phenolphthalein Alkalinity($CaCO_3$)	Nil	Silica (SiO_2)	28
Nitrate (NO_3)	0.3	0.01	Methyl Orange Alkalinity ($CaCO_3$)	124	Nitrite (N)	
Chloride (Cl)	216	6.09	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.07
Sulfate (SO_4)	31	0.64	Calcium Hardness ($CaCO_3$)	60	Ammonia (N)	24
Bicarbonate (HCO_3)	140	2.30	Magnesium Hardness ($CaCO_3$)	62	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	92	Total Nitrogen (N)	
H. Phosphate (HPO_4)	17	0.35	Dissolved Residue - Calculated	523	Boron (B)	
H_2Phosphate (H_2PO_4)	1	0.01	Dissolved Residue - Evaporated	520	Fluoride (F)	0.5
Total Milliequivalents per Liter		9.41	Loss on Ignition		Total Phosphate (PO_4)	18
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	25	1.38	Suspended Matter, total		M B A S	
Sodium (Na)	104	4.52	Suspended Matter, volatile		Grease	
Potassium (K)	13	0.33				
Calcium (Ca)	24	1.20	Sp. Cond. - Micromhos 25°C	911		
Magnesium (Mg)	15	1.23	Hydrogen Ion Concentration (pH)	8.0		
Total Milliequivalents per Liter		8.66	Sodium Percent			

Comments: Sample preserved with chloroform.

Analyst A. Jeong, J. Tyler, S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WASTEWATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Anal. No. 11831

Report to: Mr. Warren Uhte — Date Collected: 8/12-18/70

Copies to: — Date Received: 8/13-19/70

Source of Sample: Richmond-Sunset WPCP, Elutriation Overflow, Weekly Composite of Daily Composites — Date Reported: 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.05	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	30
Nitrate (NO_3)	0.6	0.01	Methyl Orange Alkalinity ($CaCO_3$)	728	Nitrite (N)	
Chloride (Cl)	139	3.92	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.14
Sulfate (SO_4)	19	0.40	Calcium Hardness ($CaCO_3$)	86	Ammonia (N)	172
Bicarbonate (HCO_3)	870	14.27	Magnesium Hardness ($CaCO_3$)	87	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	173	Total Nitrogen (N)	
H. Phosphate (HPO_4)	28	0.58	Dissolved Residue - Calculated	823	Boron (B)	
H_2Phosphate (H_2PO_4)	8	0.08	Dissolved Residue - Evaporated	628	Fluoride (F)	0.7
Total Milliequivalents per Liter		19.27	Loss on Ignition		Total Phosphate (PO_4)	36
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	182	10.07	Suspended Matter, total		M B A S	
Sodium (Na)	81	3.52	Suspended Matter, volatile		Grease	
Potassium (K)	23	0.59				
Calcium (Ca)	34	1.36	Sp. Cond. - Micromhos 25°C	1930		
Magnesium (Mg)	21	1.73	Hydrogen Ion Concentration (pH)	7.3		
Total Milliequivalents per Liter		17.27	Sodium Percent			

Comments: Sample preserved with chloroform.

Analyst: A. Jeong, J. Tyler, S. Kirby

Reported by: Morris Lipschuetz
Morris Lipschuetz

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/15/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70787	70817	70818	
SOURCE OF SAMPLE: Richmond-Sunset WPCP	Raw Sludge to Digester	Raw Sludge to Digester	Raw Sludge to Digester	
TREATMENT:				
DATE COLLECTED:	8/12/70	8/13/70	8/14/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	26	18	18	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/16, 17/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70828	70833	70842	
SOURCE OF SAMPLE: Richmond-Sunset WPCP		Raw Sludge to Digester	Raw Sludge to Digester	Raw Sludge to Digester	
TREATMENT:					
DATE COLLECTED:		8/15/70	8/16/70	8/17/70	
TIME COLLECTED:	Composite	0000-2400	0000-2400		

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	34	20	22	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/19/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70851
SOURCE OF SAMPLE: Richmond-Sunset WPCP	Raw Sludge Digester
TREATMENT:	
DATE COLLECTED:	8/18/70
TIME COLLECTED: Composite	0000-2400

Analysis	Units	ANALYTICAL RESULTS
SULFIDES	Mg/L	24

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/18/70
Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70842	70843	70844	70845
SOURCE OF SAMPLE: Richmond-Sunset WPCP		Raw Sludge Digester	Plant Influent	Upstream of Bar Screen	Sed. Tank Effluent
TREATMENT:					
DATE COLLECTED:		8/17/70	8/18/70	8/18/70	8/18/70
TIME COLLECTED: Composite		0000-2400	Peak Flow	Peak Flow	Peak Flow
Analysis	**Units**	ANALYTICAL RESULTS			
SULFIDES	Mg/L	22	<0.1	<0.1	<0.1

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/13/70
Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70784	70785	70786	
SOURCE OF SAMPLE: Richmond-Sunset WPCP		Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:					
DATE COLLECTED:		8/12/70	8/12/70	8/12/70	
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	
Analysis	**Units**	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.19	0.17	0.16	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/14/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70780	70781	70782	
SOURCE OF SAMPLE: Richmond-Sunset WPCP	Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:				
DATE COLLECTED:	8/13/70	8/13/70	8/13/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.16	0.18	0.15	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/15/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70814	70815	70816	
SOURCE OF SAMPLE: Richmond-Sunset		Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:					
DATE COLLECTED:		8/14/70	8/14/70	8/14/70	
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	
Analysis	**Units**	**ANALYTICAL RESULTS**			
PHENOLS	Mg/L	0.09	0.12	0.08	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/16/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70825	70826	70827	
SOURCE OF SAMPLE: Richmond-Sunset WPCP	Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:				
DATE COLLECTED:	8/15/70	8/15/70	8/15/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.08	0.05	0.09	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/17/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70831	70832	70840	
SOURCE OF SAMPLE: Richmond-Sunset WPCP	Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:				
DATE COLLECTED:	8/16/70	8/16/70	8/16/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.05	0.13	0.08	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/18/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES   REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70838	70839	70841	
SOURCE OF SAMPLE: Richmond-Sunset WPCP	Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:				
DATE COLLECTED:	8/17/70	8/17/70	8/17/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.07	0.07	0.10	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received	8/19/70
Reported	9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70848	70849	70850	
SOURCE OF SAMPLE: Richmond-Sunset WPCP		Plant Influent	Plant Effluent	Elutriation Tank Overflow	
TREATMENT:					
DATE COLLECTED:		8/18/70	8/18/70	8/18/70	
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	
Analysis	**Units**		ANALYTICAL RESULTS		
PHENOLS	Mg/L	0.07	0.09	0.06	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/13-14/70
Reported 8/26/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 Mint Street, San Francisco, California 94103

LAB NO.		70773	70772	70779	70778
SOURCE OF SAMPLE: City & County of San Francisco; Richmond-Sunset Sewage Treatment Plant		Influent	Effluent	Influent	Effluent
DATE COLLECTED:		8/12/70	8/12/70	8/13/70	8/13/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aquarium Seawater
Number of Fish per Concentration 10
Test Fish Stickleback
Source of Fish San Pablo Bay
Test Temperature 20° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.9	7.7	7.5	7.9
T al Alkalinity ($CaCO_3$)	MG/L	139	133	150	140
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	7.2	7.9	6.0	8.0
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	0	0	40	0
Survival in Undiluted Wastewater (48 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (96 hrs)	%	0	0	0	0
Median Tolerance Limit (TLm_{24})	%	63	75	86	56
Median Tolerance Limit (TLm_{48})	%	47	32	24	20
Median Tolerance Limit (TLm_{96})	%	32	29	22	20

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/15-16/70

Reported 8/26/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 Mint Street, San Francisco, California 94103

LAB NO.	70819	70820	70821	70822
SOURCE OF SAMPLE: City & County of San Francisco; Richmond-Sunset Sewage Treatment Plant	Influent	Effluent	Influent	Effluent
DATE COLLECTED:	8/14/70	8/14/70	8/15/70	8/15/70
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aquarium Seawater
Number of Fish per Concentration 10

Test Fish Stickleback
Source of Fish San Pablo Bay
Test Temperature 20° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.9	8.1	8.0	8.3
T al Alkalinity ($CaCO_3$)	MG/L	138	137	144	140
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	6.6	7.9	7.3	7.7
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (48 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (96 hrs)	%	0	0	0	0
Median Tolerance Limit (TLm_{24})	%	79	77	63	17
Median Tolerance Limit (TLm_{48})	%	75	27	46	17
Median Tolerance Limit (TLm_{96})	%	75	19	46	17

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/17/70

Reported 8/26/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 Mint Street, San Francisco, California 94103

LAB NO.	70823	70824	70829	70830
SOURCE OF SAMPLE: City & County of San Francisco; Richmond-Sunset Sewage Treatment Plant	Influent	Effluent	Influent	Effluent
DATE COLLECTED:	8/16/70	8/16/70	8/16/70	8/16/70
TIME COLLECTED:	Peak Flow Grab	Peak Flow Grab	Composite 0000-2400	Composite 0000-2400

Source of Dilution Water Steinhart Aquarium Seawater
Number of Fish per Concentration 10

Test Fish Stickleback
Source of Fish San Pablo Bay
Test Temperature 20° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	8.0	8.6	7.9	8.1
T al Alkalinity ($CaCO_3$)	MG/L	163	170	128	132
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	6.3	7.9	7.8	7.0
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (48 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (96 hrs)	%	0	0	0	0
Median Tolerance Limit (TLm_{24})	%	52	16	78	29
Median Tolerance Limit (TLm_{48})	%	36	13	44	16
Median Tolerance Limit (TLm_{96})	%	32	10	40	16

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/18-19/70

Reported 8/26/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 Mint Street, San Francisco, California 94103

LAB NO.	70836	70837	70859	70860
SOURCE OF SAMPLE: City & County of San Francisco; Richmond-Sunset Sewage Treatment Plant	Influent	Effluent	Influent	Effluent
DATE COLLECTED:	8/17/70	8/17/70	8/18/70	8/18/70
TIME COLLECTED:	Composite 0000-2400	Composite 0000-2400	Peak Flow Grab	Peak Flow Grab

Source of Dilution Water Steinhart Aquarium Seawater
Number of Fish per Concentration 10

Test Fish Stickleback
Source of Fish San Pablo Bay
Test Temperature 20° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	8.1	8.4	8.0	8.0
T al Alkalinity ($CaCO_3$)	MG/L	145	142	152	142
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	7.8	6.4	7.0	7.6
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (48 hrs)	%	0	0	0	0
Survival in Undiluted Wastewater (96 hrs)	%	0	0	0	0
Median Tolerance Limit (TLm_{24})	%	80	68	72	80
Median Tolerance Limit (TLm_{48})	%	63	25	46	63
Median Tolerance Limit (TLm_{96})	%	63	22	46	37

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/19/70

Reported 8/26/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 Mint Street, San Francisco, California 94103

LAB NO.	70846	70847		
SOURCE OF SAMPLE: City & County of San Francisco; Richmond-Sunset Sewage Treatment Plant	Influent	Effluent		
DATE COLLECTED:	8/18/70	8/18/70		
TIME COLLECTED: Composite	0000-2400	0000-2400		

Source of Dilution Water Steinhart Aquarium Seawater
Number of Fish per Concentration 10

Test Fish Stickleback
Source of Fish San Pablo Bay
Test Temperature 20° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	8.1	7.9		
T al Alkalinity ($CaCO_3$)	MG/L	132	125		
Residual Chlorine	MG/L	---	< 0.1		
Dissolved Oxygen	MG/L	7.8	7.4		
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	0	10		
Survival in Undiluted Wastewater (48 hrs)	%	0	0		
Survival in Undiluted Wastewater (96 hrs)	%	0	0		
Median Tolerance Limit (TLm_{24})	%	80	56		
Median Tolerance Limit (TLm_{48})	%	50	40		
Median Tolerance Limit (TLm_{96})	%	50	40		

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

G.N. Analyst

R. A. Ryder Director

R. A. Ryder

APPENDIX C-3

SOUTHEAST LABORATORY DATA SHEETS

TABLE OF CONTENTS

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Analysis No.	11809	11832	11839	11868	11879	11907	11939
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Daily Composites of Plant Influent						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
tal solids	4300	4000	3500	3500	3700	3200	3300
tal volatile solids	1500	2900	2800	1200	1300	1400	2000
tal suspended solids	460	470	500	390	300	360	490
latile suspended solids	400	380	440	350	220	290	390
oatables	1.9	3.4	7.6	2.3	2.1	2.4	3.2
ease	84	120	140	48	68	100	140
day BOD, 20°C	360	300	300	170	130	320	330
D	890	890	910	790	480	760	820
lorides (as NaCl)	-	-	-	-	-	-	-
trate (as N)	0.1	0.45	0.67	1.0	0.41	0.20	
trite (as N)	0.02	0.02	0.02	0.03	0.03	0.02	0.03
monia (as N)	11.5	14.7	18.6	19.0	20.3	18.2	15.3
ganic nitrogen (as N)	30.2	28.6	36.4	26.6	26.3	43.1	28.4
tal nitrogen (as N)	41.7	43.8	55.7	46.7	47.0	61.5	
tal dissolved phosphate (as PO_4)	13	23	20	23	20	25	19
tal phosphorus (as PO_4)	24	30	40	43	22	32	
ttleable matter, ml/l hr	10	12	12	12	8.0	11	8.5
ttleable matter, mg/l/hr	210	250	140	260	160	180	280
rbidity, JTU	61	74	98	63	70	-	97

Comments: Samples were discarded before chlorides could be determined. Sample 11837 was discarded before the grease could be determined.

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1/7

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/7

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11791	11807	11837	11869	11872	11884	11915
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Grab Sample of Plant Influent at Peak Flow						
	8/26	8.27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total suspended solids	380	430	240	420	300	420	420
Volatile suspended solids	330	310	170	370	230	330	370
Floatables	3.4	4.6	1.4	4.2	4.8	6.2	6.3
Grease	96	82	-	180	42	130	160
COD	850	1100	1200	930	560	890	1300
Nitrate (as N)	0.32	1.6		0.47	0.38		
Nitrite (as N)	0.03	0.03		0.02	0.02	0.31	0.01
Ammonia (as N)	22.0	34.5	37.1	50.5	21.8	21.7	15.9
Organic nitrogen (as N)	27.3	36.3	49.8	38.1	22.8	32.0	34.0
Total nitrogen (as N)	49.6	72.4		89.1	45.0		
Total dissolved phosphate (as PO_4)	23	21	35	19	31	27	31
Total phosphorus (as PO_4)	28	32	37	43	39	40	40
Settleable matter, ml/l/hr	11	10	0.5	18	10	8.0	8.0
Settleable matter, mg/l/hr	290	290	Nil	310	160	250	290
Turbidity, JTU	88	86	63	63	70	88	100

Comments:

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Analysis No.	11810	11833	11840	11869	11880	11908	11940
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Daily Composites of Plant Effluent						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
tal solids	3300	3200	3400	3700	3800	3400	3300
tal volatile solids	1400	1900	2600	910	1500	1500	1400
tal suspended solids	360	210	270	260	240	280	340
latile suspended solids	300	150	210	180	170	200	280
oatables	1.2	1.5	2.4	4.2	1.9	2.3	1.5
ease	60	72	77	28	66	65	80
Day BOD, 20°C	210	160	200	150	140	160	300
D	770	660	680	540	460	500	630
lorides (as NaCl)	-	-	-	-	-	-	-
trate (as N)	0.32	0.32	0.32	0.48	0.1	0.18	0.42
trite (as N)	0.02	0.02	0.02	0.02	0.03	0.03	0.02
monia (as N)	22.2	26.1	24.8	25.8	24.0	22.2	22.3
ganic nitrogen (as N)	26.7	20.1	29.6	32.1	25.2	42.5	23.9
tal nitrogen (as N)	49.2	46.5	54.7	58.4	49.8	64.9	
tal dissolved phosphate (as PO_4)	18	19	24	24	20		
tal phosphorus (as PO_4)	21	22	36	37	22	28	93
ttleable matter, ml/l/hr	2.6	0.9	1.8	1.4	0.9	1.5	3.0
ttleable matter, mg/l/hr	170		80	100	30	80	160
rbidity, JTU	78	64	68	60	81		80

Comments:

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Analysis No.	11792	11808	11838	11861	11873	11885	11916
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Grab Sample of Plant Effluent at Peak Flow						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total suspended solids	270	330	630	340	220	260	260
Volatile suspended solids	230	300	480	300	150	190	200
Floatables	5.8	2.4	6.7	7.0	2.2	2.6	3.9
Grease	54	67	170	40	53	79	130
COD	730	960	640	660	520	520	780
Nitrate (as N)	0.97	0.37	0.1	0.54	0.52	0.29	0.32
Nitrite (as N)	0.04	0.04		0.05	0.03	4.8	0.01
Ammonia (as N)	24.8	27.2	36.0	22.3	39.5	34.4	22.5
Organic nitrogen (as N)	26.2	27.8	36.6	29.1	36.6	32.1	22.3
Total nitrogen (as N)	52.0	55.4		52.0	76.6	71.6	
Total dissolved phosphate (as PO_4)	18	19	23	15	18		
Total phosphorus (as PO_4)	26	26	39	31	39	12	19
Settleable matter, ml/l/hr	0.8	1.5	11	1.9	1.0	0.8	0.9
Settleable matter, mg/l/hr	30	90	450	150	30	40	130
Turbidity, JTU	88	87	92	56	78	85	100

Comments:

Reported by Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 — Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Analysis No.	11822	11844	11849	11876	11912	11934	11952	
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Raw Sludge from Southeast Plant							
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	
DETERMINATION	%	%	%	%	%	%	%	
tal solids	4.4	3.5	5.0	7.4	6.9	5.2	4.6	
latile solids(% of total solids)	67	68	67	65	66	68	67	
ease (% of total solids)	-	32	31	24	28	33	31	
D	5.8	5.8	7.3	7.7	8.7	8.6	8.5	
lorides (as NaCl)	-	-	-	0.19	-	-	-	
monia					0.011		0.015	
ganic nitrogen (as N)					0.20		0.13	
tal nitrogen					0.21		0.14	
tal phosphorus					0.22			

Comments: The samples deteriorated and were discarded before chlorides could be determined (except for Analysis No. 11876).

Reported by Morris Lipschultz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11824	11843	11848	11874	11962	11936	11950
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Raw Sludge from North Point WPCP						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	%	%	%	%	%	%	%
Total solids	0.91	0.89	0.70	0.65	0.80	0.41	0.65
Volatile solids (% of total solids)	69	71	72	75	71	74	73
Grease (% of total solids)	-	5.3	29	-	-	-	21
COD	1.6	1.5	1.4	0.82	0.79	1.3	1.5
Chlorides (as NaCl)	-	0.09	0.10	-	-	-	-
Ammonia					0.0038		0.0081
Organic nitrogen					0.021		0.10
Total nitrogen					0.025		0.11
Total phosphorus					0.004		0.48

Comments: Samples 11824, 11874, 11962, 11936 and 11950, deteriorated and were discarded before chloride and grease determinations could be completed.

Reported by Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11811	11835	11842	11871	11881	11909	11941
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Thickening Tank Overflow						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1	mg/1
Total solids	21,000	11,000	9,100	9,300	6,000	10,000	-
Total volatile solids	15,000	8,000	5,900	6,400	4,500	7,800	-
Total suspended solids	11,000	7,900	6,900	6,900	3,400	8,300	-
Volatile suspended solids	8,200	5,800	5,100	5,100	2,500	6,200	-
Floatables	3.3	23.5	23.0	12.0	5.1	14.8	5.3
Grease	900	1,100	4,500	700	600	1,100	-
5-Day BOD, 20°C	2,400	2,900	4,800	1,600	5,800	3,000	5,500
COD	26,000	20,000	18,000	12,000	8,700	10,000	19,000
Chlorides (as NaCl)	-	-	-	-	-	-	-
Nitrate (as N)	-	-	-	-	-	-	-
Nitrite (as N)	-	-	-	-	-	-	-
Ammonia (as N)	54.9	53.6	53.8	73.2	73.0	35.3	75.7
Organic nitrogen (as N)	503	490	470	330	218	218	148
Total nitrogen (as N)	558	544	524	403	291	253	224
Total phosphorus (as PO_4)	620			170	240	350	860
Settleable matter, ml/l/hr	40	40	40	40	40	40	40
Settleable matter, mg/l/hr	10,000	7,000	6,100	5,900	2,600	7,200	-
Turbidity, JTU	56	53	-	-	-	-	-

Comments: Solids data on Analysis No. 11941 questionable validity, not reported.

Determination of nitrates and nitrites could not be run due to interferences of color and turbidity.

Reported by Morris Lipschutz

Thickening Tank Overflow to Grit Tank Inflow

Comments:

The solids data for Analysis No. 11941 are questionable, as are the suspended solids data for Analysis No. 11909. Nitrates and nitrites not determined because of interference due to color and turbidity of the samples. Turbidity measured after one hour settling. The value for Analysis No. 11835 is uncertain because of dark color. The remaining turbidities were not measured, the samples having been discarded.

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11823	11845	11850	11911	11913	11938	11953
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Thickener Sludge to Digester						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	%	%	%	%	%	%	%
otal solids	4.0	4.2	3.7	12	13	6.8	7.4
olatile solids (% of total solids)	71	69	69	67	68	70	68
rease (% of total solids)	-	20	29	8.3	11	12	24
OD	6.1	5.6	5.2	8.0	7.4	5.3	8.0
hlorides	-	-	0.14	-	0.15	-	0.12
mmonia					0.012		0.015
rganic nitrogen					0.19		0.17
otal nitrogen					0.20		0.18
otal phosphorus					0.16		

Comments: Samples 11823, 11845, and 11938 deteriorated and were discarded before the chloride and grease determinations could be completed.

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11826	11846	11851	11878	11914	11937	11954
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Digested Sludge to Elutriation System						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	%	%	%	%	%	%	%
Total solids	4.5	3.5	2.4	3.8	3.5	3.4	1.9
Volatile solids (% of total solids)	61	60	61	60	60	61	59
Grease (% of total solids)	-	22	14	31	41	20	20
Chlorides (as NaCl)	-	0.13	0.12	0.16	0.12	-	0.15
Alkalinity of supernatant (as $CaCO_3$) mg/l	1220	1180	1260	1230	1660	1260	1540

Comments: Samples 11826 and 11937 were discarded before the grease and chloride determinations could be made.

Reported by Morris Lifschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11825	11847	11852	11877		11935	11951	
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Elutriation Sludge to Filter							
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	
DETERMINATION	%	%	%	%		%	%	
Total solids	4.2	5.7	5.0	2.0	Sample not received	2.2	5.6	
Volatile solids (% of total solids)	58	55	57	59		62	51	
Grease (% of total solids)	-	15	18	6.9		33	20	
Chlorides (as NaCl)	-	0.15	0.18	0.18		0.14	0.19	

Comments:

Sample 11825 was discarded before the chloride and grease determinations could be made.

Reported by Morris Lifschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11812	11834	11841	11870	11882	11910	11942
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT ELUTRIATION TANK OVERFLOW						
	8/26	8/27	8/28	8/29	8/30	8/31	9/1
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Total solids	5100	6200	6300	6500	6700	7400	16,000
Total volatile solids	2500	4200	4100	4400	4000	4900	11,000
Total suspended solids	1800	3600	3600	3500	3800	4800	1,200
Volatile suspended solids	1300	2300	2200	2300	2600	3000	730
Floatables	4.9	3.9	3.3	-	6.3	5.7	1.0
Grease	250	1200	600	380	1000	910	180
5-Day BOD, 20°C	800	1100	1100	1300	1300	1500	560
COD	9800	9000	7700	4600	4700	1500	1,600
Chlorides (as NaCl)	-	-	-	-	-	-	-
Nitrate (as N)	-	-	-	-	-	-	-
Nitrite (as N)	-	-	-	-	-	-	-
Ammonia (as N)	134	109	130	101	108	91.3	97.3
Organic nitrogen (as N)	216						
Total nitrogen (as N)	350						
Total dissolved phosphate (as PO_4)	19	35	20	33	73	69	32
Total phosphorus (as PO_4)	310	340			240	200	
Settleable matter, ml/l/hr	32	40	40	40	40	40	12
Settleable matter, mg/l/hr	1300	2600	3200	3100	2800	4100	900
Turbidity, JTU	60	44	-	-	-	-	-

Comments: Nitrates and nitrites could not be determined because of interferences due to color and turbidity.

Reported by Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study - DPW 85,284 Date Collected 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers Date Received 8/26 - 9/1/70

Copies to San Francisco Department of Public Works Date Reported 11/3/70

Analysis No.	11806	11836	11853	11875		11933	11949	
Source of Sample	SOUTHEAST WATER POLLUTION CONTROL PLANT Sludge Filter Cake							
	8/26	8/27	8/28	8/29	8/30	8/31	9/1	
DETERMINATION	%	%	%	%	%	%	%	
otal solids	29	29	27	27	Sample not received	28	.24	
otal volatile solids	14	13	13	15		15	12	
oisture	71	71	73	73		72	76	
rease	0.46	0.32	0.24	0.61		0.77	0.20	

Comments:

Reported by Morris Lipschutz

Allied Life Sciences, inc.

1935 Republic Avenue, San Leandro, California 94577 (415) 351-0493

October 15, 1970

Mr. Warren Uhte
Brown & Caldwell
66 Mint Street
San Francisco, Calif.

Dear Mr. Uhte:

Following are the results of pesticide analysis done on eighteen water samples received August 27, 1970 through September 2, 1970 from the South East Sewage Treatment Plant.

The samples were analyzed for specific chlorinated hydrocarbons by use of the Varian 2100 Electron Gas Chromatograph.

All results given in parts per billion (ppb).

Explanation of abbreviations used in this report:

Effluent	- Eff.
Peak Flow	- P.F.
Influent	- Inf.

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons		
1738 A	8/26 Inf.	Lindane (L)	.13	
		Heptachlor-epoxide (HE)	<.01	*
		DDE	.27	
		DDD	.14	
		DDT	.14	
		Dieldrin (D)	.09	
1738 B	8/26 Eff.	L	.11	
		HE	<.01	*
		DDE	.38	
		DDD	.12	
		DDT	.13	
		D	.07	
1742 A	8/27 Inf.	L	**	
		HE	**	
		DDE	.44	
		DDD	.16	
		DDT	.07	
		D	.15	

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1742 B	8/27 Eff.	L	.08
		HE	<.01 *
		DDE	.21
		DDD	.14
		DDT	.13
		D	.12
1752 A	8/28 Inf.	L	.08
		HE	<.01 *
		DDE	.12
		DDD	.04
		DDT	.25
		D	.08
1752 B	8/28 Eff.	L	.07
		HE	<.01 *
		DDE	.14
		DDD	.11
		DDT	.16
		D	.10
1752 C	8/29 Inf.	L	.06
		HE	<.01 *
		DDE	.06
		DDD	.11
		DDT	.22
		D	.19
1752 D	8/29 Eff.	L	.05
		HE	<.01 *
		DDE	.10
		DDD	.16
		DDT	.25
		D	.11
1752 E	8/30 P.F. Inf.	L	.07
		HE	<.01 *
		DDE	.07
		DDD	.09
		DDT	.39
		D	.14
1752 F	8/30 P.F. Eff.	L	.05
		HE	<.01 *
		DDE	.21
		DDD	.22
		DDT	.28
		D	.12

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1752 G	8/30 Inf.	L	.14
		HE	<.01 *
		DDE	.06
		DDD	.16
		DDT	.21
		D	.19
1752 H	8/30 Eff.	L	.11
		HE	<.01 *
		DDE	.04
		DDD	.17
		DDT	.18
		D	.08
1754 A	8/31 Inf.	L	.17
		HE	<.01 *
		DDE	.02
		DDD	.06
		DDT	.10
		D	.03
1754 B	8/31 Eff.	L	.05
		HE	<.01 *
		DDE	.07
		DDD	.06
		DDT	<.05 *
		D	.02
1754 C	~~EX~~ 9/1/70 P.F. Inf.	L	.15
		HE	<.01 *
		DDE	.02
		DDD	.09
		DDT	.29
		D	.07
1754 D	9/1 P.F. Eff.	L	.04
		HE	<.01 *
		DDE	.05
		DDD	.06
		DDT	.12
		D	.01
1755 A	9/1 Inf.	L	.08
		HE	<.01 *
		DDE	.05
		DDD	.13
		DDT	.08
		D	.10

Allied Life Sciences #	Client Description	Parts Per Billion Chlorinated Hydrocarbons	
1755 B	9/1 Eff.	L	.05
		HE	< .01 *
		DDE	.02
		DDD	.03
		DDT	.10
		D	.05

* Limit of detection

** Unable to give values for Lindane and Heptachlor-epoxide due to high background level of sample.

Samples were not labeled composite

Sincerely,

Mary E. Nichols /vls

Mary E. Nichols (Smith)
Chemist

MEN/vls

METALLURGICAL LABORATORIES INC. CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-8575

SOUTHEAST

Spectrographic Analysis

Weekly Composite of Daily Composites

Submitted by Brown & Caldwell Laboratories
66 Mint Street
San Francisco, California 94103

Date September 29, 1970.

Sample of Residues

P. O. No. 1353

Lab. No. 3442

SAMPLE MARK →	Influents 11959	Effluents 11960	Elutriation 11961 Overflow	Raw Sludge 11969 from S.E.	Thickener 11970 T.overflow	Elutriation 11971 sludge	Thicker 11972 sludg
IRON %	0.15	0.25	1.00	7.00	7.00	7.00	7.00
COPPER	0.02	0.02	0.01	0.25	0.25	0.20	0.25
NICKEL	0.001	0.001	0.004	0.03	0.02	0.03	0.03
CHROMIUM	0.10	0.04	0.10	2.50	2.00	2.00	2.50
ALUMINUM	0.05	0.05	0.25	3.50	3.50	4.00	4.50
LEAD	0.002	0.002	0.002	0.08	0.10	0.10	0.10
TIN			0.002	0.03	0.03	0.03	0.04
ZINC	0.05	0.05	0.10	0.40	0.25	0.40	0.40
COBALT				0.002	0.002	0.002	0.002
MANGANESE	0.005	0.01	0.04	0.02	0.08	0.06	0.04
MOLYBDENUM				0.002	0.002	0.002	0.002
SILICON	0.30	0.30	0.80	Major	Major	Major	Major
SILVER	0.0002	0.0002	0.0008	0.02	0.02	0.02	0.02
VANADIUM	0.001	0.001	0.002	0.01	0.01	0.01	0.01
MAGNESIUM	5.00	5.00	5.00	4.00	4.00	4.00	4.0
CALCIUM	3.00	4.00	Major	7.00	7.00	7.00	7.0
Strontium	0.03	0.03	0.03	0.03	0.03	0.03	0.0
TITANIUM	0.001	0.001	0.002	0.40	0.40	0.50	0.5
BISMUTH				0.002	0.002	0.003	0.00
Sodium	Major	Major	Major	5.0	10.0	5.0	10.
Potassium	1.50	1.50	1.00	1.50	1.00	1.00	1.0

METALLURGICAL LABORATORIES, INC.

By ______________ SPECTROCHEMIST

*LESS THAN

**CHEMICAL DETERMINATION

METALLURGICAL LABORATORIES, INC. CHEMISTS • ASSAYERS • SPECTROGRAPHERS

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-8575

Southeast

Spectrographic Analysis
(Semi-quantitative)

Weekly Composite of Daily Composites

Submitted by Brown & Caldwell
66 Mint Street
San Francisco, California

Date December 8, 1970

Sample of Products

P. O. No. 6562 Receiving Water

Lab. No. 7719

SAMPLE MARK →	Week composite 11996 S2-4	Week composite 11997 O-7	Week composite 12203 Raw sludge from North Point
IRON %	0.0003	0.0001	10.00
COPPER	0.0001	0.0001	0.25
NICKEL	0.0005 *	0.0005 *	0.15
CHROMIUM	0.001 *	0.001 *	0.25
ALUMINUM	0.001	0.001	2.00
LEAD	0.001 *	0.001 *	0.18
TIN	0.001 *	0.001 *	0.10
ZINC	0.01 *	0.01 *	0.30
COBALT			0.001
MANGANESE	0.001 *	0.001 *	0.04
MOLYBDENUM			0.002
SILICON	0.002	0.002	Major
SILVER	0.0001 *	0.0001 *	0.001
VANADIUM			0.002
MAGNESIUM	Major	Major	2.50
CALCIUM	5.00	5.00	6.00
TITANIUM	0.001 *	0.001 *	0.15
BISMUTH			0.003

SAMPLE MARK →	11996	11997	12203
SODIUM %	Major	Major	Major
POTASSIUM	0.30	0.30	1.50
STRONTIUM	0.03	0.02	0.02
ZIRCONIUM			0.01
BORON	0.002	0.002	0.03
BARIUM	0.05 *	0.05 *	0.30
RARE EARTHS			
Phosphorus			4.00

*LESS THAN
**CHEMICAL DETERMINATION
Ⓜ 256342

METALLURGICAL LABORATORIES, INC.
By Robert A. Atwood
SPECTROCHEMIST

[illegible] CHEMISTS • ASSAYERS • SPECTROGRAPH[illegible]

1142 HOWARD STREET • SAN FRANCISCO, CALIFORNIA 94103 • AREA CODE 415 863-85[illegible]

Southeast

Spectrographic Analysis
(Semi-quantitative)

Weekly Composites of Daily Composites

Submitted by Brown & Caldwell
66 Mint Street
San Francisco, California

Date December 8, 1970

Sample of Products

P. O. No. 6562 Receiving Water Lab. No. 7719

SAMPLE MARK →		Week composite 11994 0-2	Week composite 11995 N2-4	SAMPLE MARK →		11994	11995
IRON %		0.0002	0.001	SODIUM %		Major	Major
COPPER		0.0001	0.0001	POTASSIUM		0.40	0.70
NICKEL *		0.0005	0.0005	STRONTIUM		0.03	0.03
CHROMIUM		0.001 *	0.001 *	ZIRCONIUM			
ALUMINUM		0.001	0.001	BORON		0.002	0.002
LEAD		0.001 *	0.001 *	BARIUM		0.05 *	0.05 *
TIN *		0.001	0.001	RARE EARTHS			
ZINC		0.01 *	0.01 *	Phosphorus			
COBALT							
MANGANESE		0.001 *	0.001 *				
MOLYBDENUM							
SILICON		0.002	0.002				
SILVER		0.0001 *	0.0001 *				
VANADIUM							
MAGNESIUM		Major	Major				
CALCIUM		4.00	5.00				
TITANIUM		0.001 *	0.001 *				
BISMUTH							

*LESS THAN
**CHEMICAL DETERMINATION

METALLURGICAL LABORATORIES, INC.
BY [signature]
SPECTROCHEMIST

WASTEWATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Anal. No. 12134

Report to: Mr. Warren Uhte — Date Collected: 8/21-9/1/70

Copies to: — Date Received: 8/22-9/2/70

Source of Sample: Southeast WPCP- Weekly Composite of Daily Influent Composites — Date Reported: 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.04	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	19
Nitrate (NO_3)	5	0.08	Methyl Orange Alkalinity ($CaCO_3$)	161	Nitrite (N)	
Chloride (Cl)	1460	41.17	Free Carbon Dioxide (CO_2)		Nitrate (N)	1.1
Sulfate (SO_4)	301	6.26	Calcium Hardness ($CaCO_3$)	179	Ammonia (N)	28
Bicarbonate (HCO_3)	194	3.18	Magnesium Hardness ($CaCO_3$)	383	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	562	Total Nitrogen (N)	
H. Phosphate (HPO_4)	4	0.08	Dissolved Residue - Calculated	2897	Boron (B)	
H_2Phosphate (H_2PO_4)	4	0.04	Dissolved Residue - Evaporated	3316	Fluoride (F)	0.8
Total Milliequivalents per Liter		50.82	Loss on Ignition		Total Phosphate (PO_4)	7.5
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	30	1.66	Suspended Matter, total		M B A S	
Sodium (Na)	810	35.24	Suspended Matter, volatile		Grease	
Potassium (K)	32	0.82				
Calcium (Ca)	72	2.88	Sp. Cond. - Micromhos 25°C	5260		
Magnesium (Mg)	93	7.64	Hydrogen Ion Concentration (pH)	6.8		
Total Milliequivalents per Liter		48.24	Sodium Percent			

Comments: Sample preserved with chloroform.

Analyst: A. Jeong, J. Tyler, S. Kirby

Reported by: Morris Lipschuetz

Morris Lipschuetz

WASTEWATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Anal. No. 12135

Report to: Mr. Warren Uhte — Date Collected: 8/26-9/1/70

Copies to: — Date Received: 8/27-9/2/70

Source of Sample: Southeast WPCP- Weekly Composite of Daily Effluent Composites — Date Reported: 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.07	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	20
Nitrate (NO_3)	0.5	0.01	Methyl Orange Alkalinity ($CaCO_3$)	151	Nitrite (N)	
Chloride (Cl)	1480	41.74	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.11
Sulfate (SO_4)	296	6.16	Calcium Hardness ($CaCO_3$)	228	Ammonia (N)	25
Bicarbonate (HCO_3)	182	2.98	Magnesium Hardness ($CaCO_3$)	369	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	597	Total Nitrogen (N)	
H. Phosphate (HPO_4)	4	0.08	Dissolved Residue - Calculated	2925	Boron (B)	
H_2Phosphate (H_2PO_4)	4	0.04	Dissolved Residue - Evaporated	3324	Fluoride (F)	1.2
Total Milliequivalents per Liter		51.02	Loss on Ignition		Total Phosphate (PO_4)	8
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	26	1.44	Suspended Matter, total		M B A S	
Sodium (Na)	818	35.58	Suspended Matter, volatile		Grease	
Potassium (K)	31	0.79				
Calcium (Ca)	91	3.64	Sp. Cond. - Micromhos 25°C	5220		
Magnesium (Mg)	90	7.40	Hydrogen Ion Concentration (pH)	6.9		
Total Milliequivalents per Liter		48.85	Sodium Percent			

Comments:

Analyst: A. Jeong, J. Tyler, S. Kirby

Reported by: Morris Lipschuetz

WASTEWATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Anal. No. 12137

Report to: Mr. Warren Uhte — Date Collected: 8/26-9/1/70

Copies to: — Date Received: 8/27-9/2/70

Source of Sample: Southeast WPCP Thickening Tank Overflow, Weekly Comp. of Daily Composites — Date Reported: 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.14	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	9
Nitrate (NO_3)	0.6	0.01	Methyl Orange Alkalinity ($CaCO_3$)	366	Nitrite (N)	
Chloride (Cl)	1090	30.74	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.14
Sulfate (SO_4)	102	2.12	Calcium Hardness ($CaCO_3$)	525	Ammonia (N)	59
Bicarbonate (HCO_3)	445	7.30	Magnesium Hardness ($CaCO_3$)	76	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	601	Total Nitrogen (N)	
H. Phosphate (HPO_4)	2	0.04	Dissolved Residue - Calculated	2289	Boron (B)	
H_2Phosphate (H_2PO_4)	10	0.10	Dissolved Residue - Evaporated	3008	Fluoride (F)	1.1
Total Milliequivalents per Liter		40.32	Loss on Ignition		Total Phosphate (PO_4)	12
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	62	3.43	Suspended Matter, total		M B A S	
Sodium (Na)	597	25.97	Suspended Matter, volatile		Grease	
Potassium (K)	31	0.79				
Calcium (Ca)	210	8.40	Sp. Cond. - Micromhos 25°C	4290		
Magnesium (Mg)	18	1.50	Hydrogen Ion Concentration (pH)	6.0		
Total Milliequivalents per Liter		40.09	Sodium Percent			

Comments:

Sample preserved with chloroform.

Analyst: A. Jeong, J. Tyler, S. Kirby

Reported by: Morris Lipschuetz
Morris Lipschuetz

WASTEWATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Anal. No. 12136

Report to Mr. Warren Uhte — Date Collected 8/26-9/1/70

Copies to — Date Received 8/27-9/2/70

Source of Sample Southeast WPCP Elutriation Tank Overflow, Weekly Composite of Daily Composites — Date Reported 2/22/71

ANIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	DETERMINATION	MILLIGRAMS PER LITER	DETERMINATION	MILLIGRAMS PER LITER
Nitrite (NO_2)	0.07	0.01	Phenolphthalein Alkalinity ($CaCO_3$)	Nil	Silica (SiO_2)	20
Nitrate (NO_3)	0.4	0.01	Methyl Orange Alkalinity ($CaCO_3$)	780	Nitrite (N)	
Chloride (Cl)	1260	35.53	Free Carbon Dioxide (CO_2)		Nitrate (N)	0.09
Sulfate (SO_4)	154	3.20	Calcium Hardness ($CaCO_3$)	548	Ammonia (N)	129
Bicarbonate (HCO_3)	949	15.56	Magnesium Hardness ($CaCO_3$)	219	Organic Nitrogen (N)	
Carbonate (CO_3)			Total Hardness ($CaCO_3$)	767	Total Nitrogen (N)	
H. Phosphate (HPO_4)	4	0.08	Dissolved Residue - Calculated	2882	Boron (B)	
H_2Phosphate (H_2PO_4)	1	0.01	Dissolved Residue - Evaporated	3188	Fluoride (F)	0.8
Total Milliequivalents per Liter		54.40	Loss on Ignition		Total Phosphate (PO_4)	5
CATIONS	MILLIGRAMS PER LITER	MILLIEQUIV PER LITER	Fixed Residue		Chlorine Residual (Cl)	
Ammonium (NH_4)	136	7.52	Suspended Matter, total		M B A S	
Sodium (Na)	674	29.32	Suspended Matter, volatile		Grease	
Potassium (K)	29	0.74				
Calcium (Ca)	219	8.77	Sp. Cond. - Micromhos 25°C	5300		
Magnesium (Mg)	53	4.36	Hydrogen Ion Concentration (pH)	7.5		
Total Milliequivalents per Liter		50.71	Sodium Percent			

Comments:

Sample preserved with chloroform.

Analyst A. Jeong, J. Tyler, S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/27/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70991	70992	70993	
SOURCE OF SAMPLE: Southeast WPCP		Raw	Thickened Sludge to Digester	Raw Sludge ~~North Point~~ WPCP	
		----Southeast WPCP----			
TREATMENT:					
DATE COLLECTED:		8/26/70	8/26/70	8/26/70	
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	120	220	16	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/28/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES   REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70998	70999	701000
SOURCE OF SAMPLE: Southeast WPCP	Raw Sludge	Thickened Sludge	Raw Sludge
	----Southeast WPCP----		North Point WPCP
TREATMENT:			
DATE COLLECTED:	8/27/70	8/27/70	8/27/70
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS		
SULFIDES	Mg/L	60	110	22

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/29/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70904	70905	70906	
SOURCE OF SAMPLE: Southeast WPCP	Thickened Sludge	Raw Sludge	Raw Sludge	
	----Southeast	WPCP----	North Point ~~WPCP~~	
TREATMENT:				
DATE COLLECTED:	8/28/70	8/28/70	8/28/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	216	226	32	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/30/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70959	70960	70961	
SOURCE OF SAMPLE: Southeast WPCP	Raw Sludge	Thickened Sludge	Raw Sludge	
	----Southeast	WPCP----	North Point ~~WPCP~~	
TREATMENT:				
DATE COLLECTED:	8/29/70	8/29/70	8/29/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	238	232	24	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received	8/31/70
Reported	10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70966	70967	70968	
SOURCE OF SAMPLE: Southeast WPCP	Raw Sludge	Thickened Sludge	Raw Sludge	
	----Southeast WPCP----		North Point ~~WPCP~~	
TREATMENT:				
DATE COLLECTED:	8/30/70	8/30/70	8/30/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	640	200	18	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 9/1/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70973	70974	70975	
SOURCE OF SAMPLE: Southeast WPCP	Raw Sludge	Thickener Tank	Raw Sludge	
	----Southeast WPCP----		North Point WPCP	
TREATMENT:				
DATE COLLECTED:	8/31/70	8/31/70	8/31/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	400	220	40	

COMMENTS:

S.D. Analyst

R. A. Ryder Director

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 9/2/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70980	70981	70982	
SOURCE OF SAMPLE: Southeast WPCP	Raw Sludge	Thickener Tank	Raw Sludge	
	----Southeast WPCP----		North Point ~~WPCP~~	
TREATMENT:				
DATE COLLECTED:	9/1/70	9/1/70	9/1/70	
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	500	260	46	

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 9/2/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70983	70984	70985	70986
SOURCE OF SAMPLE: Southeast WPCP	Upstream at Bar Screen	Pump Discharge Chamber	Sed. Tank Influent	Sed. Tank Effluent
TREATMENT:				
DATE COLLECTED:	9/1/70	9/1/70	9/1/70	9/1/70
TIME COLLECTED:	---	---	---	---

Analysis	Units	ANALYTICAL RESULTS			
SULFIDES	Mg/L	<0.1	<0.1	0.1	0.3

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/27/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70987	70988	70989	70990
SOURCE OF SAMPLE: Southeast WPCP	Plant Influent	Plant Effluent	Thickener Overflow	Elutriation Tank Overflow
TREATMENT:				
DATE COLLECTED:	8/26/70	8/26/70	8/26/70	8/26/70
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS			
Phenols	Mg/L	0.13	0.15	0.20	0.80

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/28/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70994	70995	70996	70997
SOURCE OF SAMPLE: Southeast WPCP		Plant Influent	Plant Effluent	Thickener Overflow	Elutriation Tank Overflow
TREATMENT:					
DATE COLLECTED:		8/27/70	8/27/70	8/27/70	8/27/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.18	0.10	0.46	0.53

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/29/70

Reported 9/23/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70900	70901	70902	70903
SOURCE OF SAMPLE: Southeast WPCP	Plant Influent	Plant Effluent	Thickener Tank Overflow	Elutriation Tank Overflow
TREATMENT:				
DATE COLLECTED:	8/28/70	8/28/70	8/28/70	8/28/70
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.18	0.15	0.14	0.08

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/30/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN AND CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70955	70956	70957	70958
SOURCE OF SAMPLE: Southeast WPCP		Plant Influent	Plant Effluent	Thickener Overflow	Elutriation Tank Overflow
TREATMENT:					
DATE COLLECTED:		8/29/70	8/29/70	8/29/70	8/29/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400
Analysis	**Units**	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.07	0.17	0.11	0.06

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 8/31/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

OR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

DDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

AB NO.		70962	70963	70964	70965
OURCE OF SAMPLE: Southeast WPCP		Plant Influent	Plant Effluent	Thickener Overflow	Elutriation Tank Overflow
REATMENT:					
ATE COLLECTED:		8/30/70	8/30/70	8/30/70	8/30/70
IME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400
nalysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.04	0.13	0.12	0.11

OMMENTS:

nalysis by: "Standard Methods for the Examination
f Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 9/1/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70969	70970	70971	70972
SOURCE OF SAMPLE: Southeast WPCP	Plant Influent	Plant Effluent	Thickener Overflow	Elutriation Tank Overflow
TREATMENT:				
DATE COLLECTED:	8/31/70	8/31/70	8/31/70	8/31/70
TIME COLLECTED: Composite	0000-2400	0000-2400	0000-2400	0000-2400

Analysis	Units	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.12	0.08	0.07	0.07

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco 94105
Phone - (415) 362-6065

Received 9/2/70

Reported 10/6/70

WASTEWATER ANALYSIS REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70976	70977	70978	70979
SOURCE OF SAMPLE: Southeast WPCP		Plant Influent	Plant Effluent	Thickener Overflow	Elutriation Tank Overflow
TREATMENT:					
DATE COLLECTED:		9/1/70	9/1/70	9/1/70	9/1/70
TIME COLLECTED: Composite		0000-2400	0000-2400	0000-2400	0000-2400
Analysis	**Units**	ANALYTICAL RESULTS			
PHENOLS	Mg/L	0.19	0.18	0.05	0.06

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater", Current Edition, APHA

P.M. & S.D. Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received	8/27-8/28/70
Reported	9/15/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES   REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70887	70888	70890	70891
SOURCE OF SAMPLE: City of San Francisco		Southeast STP Pl. Infl.	Southeast STP Pl. Effl.	Southeast STP Pl. Infl.	Southeast STP Pl. Effl.
DATE COLLECTED:		8/26/70	8/26/70	8/27/70	8/27/70
TIME COLLECTED:		0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	8.1	8.1	8.1	8.1
:al Alkalinity ($CaCO_3$)	MG/L	235	175	152	184
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	7.4	7.2	6.2	7.0
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	60	60	100	70
Survival in Undiluted Wastewater (48 hrs)	%	0	10	100	0
Survival in Undiluted Wastewater (96 hrs)	%	0	0	80	0
Median Tolerance Limit (TLm_{24})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm_{48})	%	80	82	>100	80
Median Tolerance Limit (TLm_{96})	%	80	80	>100	80

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN, GN Analyst

Robert M. Kennedy ~~Director~~

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/29-8/30/70

Reported 9/15/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70896	70897	70910	70911
SOURCE OF SAMPLE: City of San Francisco		Southeast STP Pl. Infl.	Southeast STP Pl. Effl.	Southeast STP Pl. Infl.	Southeast STP Pl. Effl.
DATE COLLECTED:		8/28/70	8/28/70	8/29/70	8/29/70
TIME COLLECTED:		0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.9	8.3	8.2	8.3
Total Alkalinity ($CaCO_3$)	MG/L	---	210	161	205
Residual Chlorine	MG/L	---	<0.1	---	<0.1
Dissolved Oxygen	MG/L	6.7	7.8	7.8	8.1
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	100	0	30	0
Survival in Undiluted Wastewater (48 hrs)	%	90	0	10	0
Survival in Undiluted Wastewater (96 hrs)	%	90	0	0	0
Median Tolerance Limit (TLm_{24})	%	>100	63	77	63
Median Tolerance Limit (TLm_{48})	%	>100	63	67	63
Median Tolerance Limit (TLm_{96})	%	>100	63	63	63

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN, GN Analyst

Robert M. Kennedy ~~Director~~

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/31/-9/1/70

Reported 9/15/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70915	70916	70919	70920
SOURCE OF SAMPLE: City of San Francisco	Southeast STP Pl. Infl.	Southeast STP Pl. Effl.	Southeast STP Pl. Infl.	Southeast STP Pl. Effl.
DATE COLLECTED:	8/30/70	8/30/70	8/31/70	8/31/70
TIME COLLECTED:	0000-2400	0000-2400	0000-2400	0000-2400

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.7	8.1	7.7	7.7
al Alkalinity ($CaCO_3$)	MG/L	155	237	180	235
Residual Chlorine	MG/L	---	< 0.1	---	< 0.1
Dissolved Oxygen	MG/L	6.1	7.2	6.6	6.2
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	10	0	100	90
Survival in Undiluted Wastewater (48 hrs)	%	0	0	100	70
Survival in Undiluted Wastewater (96 hrs)	%	0	0	0	0
Median Tolerance Limit (TLm_{24})	%	66	60	>100	>100
Median Tolerance Limit (TLm_{48})	%	63	60	>100	>100
Median Tolerance Limit (TLm_{96})	%	63	60	66	66

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN, GN Analyst

Robert M. Kennedy ~~Director~~

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/30 & 9/2/70

Reported 9/15/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

'OR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

DDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

AB NO.		70942	70943	70940	70941
OURCE OF SAMPLE: City of San Francisco		Southeast STP Pl. Infl.	Southeast STP Pl. Effl.	Southeast STP Pl. Infl.	Southeast STP Pl. Effl.
ATE COLLECTED:		9/1/70	9/1/70	8/30/70	8/30/70
IME COLLECTED:		0000-2400	0000-2400	Peak Flow Grab	Peak Flow Grab

ource of Dilution Water Steinhart Aqu.-Filtered Seawater
umber of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

nalysis	Units	ANALYTICAL RESULTS			
NITIAL WASTEWATER CHARACTERISTICS:					
H	Unit	7.7	7.9	8.1	8.3
al Alkalinity ($CaCO_3$)	MG/L	150	200	151	220
esidual Chlorine	MG/L	---	<0.1	---	<0.1
issolved Oxygen	MG/L	5.8	7.0	7.9	8.0
IOASSAY RESULTS:					
urvival in Undiluted Vastewater (24 hrs)	%	100	100	60	0
urvival in Undiluted Vastewater (48 hrs)	%	100	40	0	0
urvival in Undiluted Vastewater (96 hrs)	%	90	0	0	0
ledian Tolerance Limit (TLm_{24})	%	>100	> 100	100	60
ledian Tolerance Limit (TLm_{48})	%	>100	85	63	60
ledian Tolerance Limit (TLm_{96})	%	>100	63	63	40

OMMENTS:

nalysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN GN Analyst

Robert M. Kennedy ~~Director~~

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 9/2/70

Reported 9/14/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70923	70924		
SOURCE OF SAMPLE: City of San Francisco		Southeast STP Pl. Infl.	Southeast STP Pl. Effl.		
DATE COLLECTED:		9/1/70	9/1/70		
TIME COLLECTED:		Peak Flow Grab	Peak Flow Grab		

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10

Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.6	7.9		
tal Alkalinity ($CaCO_3$)	MG/L	98	215		
Residual Chlorine	MG/L	---	<0.1		
Dissolved Oxygen	MG/L	6.3	6.7		
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	10	100		
Survival in Undiluted Wastewater (48 hrs)	%	10	80		
Survival in Undiluted Wastewater (96 hrs)	%	10	0		
Median Tolerance Limit (TLm^{24})	%	60	>100		
Median Tolerance Limit (TLm^{48})	%	48	>100		
Median Tolerance Limit (TLm^{96})	%	48	63		

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN, GN Analyst

Robert M. Kennedy ~~Director~~

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/27-8/30/70

Reported 9/28/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70892	70895	70898	70912
SOURCE OF SAMPLE:	0-2	0-2	0-2	0-2
DATE COLLECTED:	8/26/70	8/27/70	8/28/70	8/29/70
TIME COLLECTED:	---	---	---	---

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10

Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.9	7.9	7.7	7.7
Total Alkalinity ($CaCO_3$)	MG/L	110	109	---	---
Residual Chlorine	MG/L	---	---	---	---
Dissolved Oxygen	MG/L	8.0	7.9	7.3	7.3
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	100	100	100	100
Survival in Undiluted Wastewater (48 hrs)	%	100	100	100	100
Survival in Undiluted Wastewater (96 hrs)	%	100	90	100	100
Median Tolerance Limit (TLm_{24})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm_{48})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm_{96})	%	>100	>100	>100	>100

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

GN Analyst

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/31-9/1/70

Reported 9/28/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.		70917	70921	70944	70913
SOURCE OF SAMPLE:		0-2	0-2	0-2	NC-6
DATE COLLECTED:		8/30/70	8/31/70	9/1/70	8/29/70
TIME COLLECTED:		---	---	---	---

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10
Test Fish Three Spine Stickleba
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.8	7.8	8.0	7.8
Total Alkalinity ($CaCO_3$)	MG/L	---	---	---	---
Residual Chlorine	MG/L	---	---	---	---
Dissolved Oxygen	MG/L	7.6	7.5	7.6	7.4
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	100	100	100	100
Survival in Undiluted Wastewater (48 hrs)	%	100	100	100	100
Survival in Undiluted Wastewater (96 hrs)	%	100	100	100	100
Median Tolerance Limit (TLm^{24})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm^{48})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm^{96})	%	>100	>100	>100	>100

COMMENTS:

TN, GN Analyst

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

R. A. Ryder Director

R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received	9/1/-9/2/70
Reported	9/28/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70922	70899	70945	70894
SOURCE OF SAMPLE:	S2-7	C	0-6	0-10
DATE COLLECTED:	8/31/70	8/28/70	9/1/70	8/27/70
TIME COLLECTED:	---	---	---	---

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.8	7.7	8.0	7.8
Total Alkalinity ($CaCO_3$)	MG/L	---	---	---	---
Residual Chlorine	MG/L	---	---	---	---
Dissolved Oxygen	MG/L	7.4	7.4	7.6	8.0
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	100	100	100	100
Survival in Undiluted Wastewater (48 hrs)	%	100	100	100	100
Survival in Undiluted Wastewater (96 hrs)	%	100	100	100	90
Median Tolerance Limit (TLm_{24})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm_{48})	%	>100	>100	>100	>100
Median Tolerance Limit (TLm_{96})	%	>100	>100	>100	>100

COMMENTS:

GN Analyst

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 8/27-8/30/70

Reported 9/28/70

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL LABORATORIES REPORT TO MR. MORRIS LIPSCHUETZ

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	70893	70918		
SOURCE OF SAMPLE:	Islais	Islais		
DATE COLLECTED:	8/26/70	8/30/70		
TIME COLLECTED:	---	---		

Source of Dilution Water Steinhart Aqu.-Filtered Seawater
Number of Fish per Concentration 10
Test Fish Three Spine Sticklebac
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5° C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.9	7.7		
Total Alkalinity ($CaCO_3$)	MG/L	---	---		
Residual Chlorine	MG/L	---	---		
Dissolved Oxygen	MG/L	7.8	7.4		
BIOASSAY RESULTS:					
Survival in Undiluted Wastewater (24 hrs)	%	100	100		
Survival in Undiluted Wastewater (48 hrs)	%	100	100		
Survival in Undiluted Wastewater (96 hrs)	%	100	100		
Median Tolerance Limit (TLm^{24})	%	>100	>100		
Median Tolerance Limit (TLm^{48})	%	>100	>100		
Median Tolerance Limit (TLm^{96})	%	>100	>100		

COMMENTS:

GN Analyst

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

[signature] Director
R. A. Ryder

REPORT ON

BACTERIOLOGICAL EXAMINATION OF WATER

FROM THE LABORATORIES OF

BROWN AND CALDWELL

For Brown and Caldwell Consulting Engineers — Exam. No. 55547-55548, 55564-55565

Report to Mr. Warren Uhte

Copies to

Date Reported 2/22/71

DATE TAKEN	DATE AND NO. OF EXAM.	SOURCE OF SAMPLE	BACTERIA PER ML. AGAR 35° C	EXAMINATION FOR COLIFORM ORGANISMS — PORTIONS EXAMINED: Size	No.	PRESUMPTIVE LACTOSE BROTH: 24 Hr.	48 Hr.	CONFIRMED B.G.B.: 24 Hr.	48 Hr.	COLIFORM ORGANISMS MOST PROBABLE NUMBER per 100 ml.	QUALITY AT TIME OF SAMPLING: Safe	Unsafe
/26	8/26 55547	S. F. Bay, 0 - 2		10 ml.	3	3		2	1			
				1.0 ml.	3	0	2		2			
				0.1 ml.	3	0	1		1			
			.01	XXXX	3	0	0					
			.001	XXXXX	3	0				150		
				0.1 ml.								
/26	8/26 55548	S.F. Bay, Islais Creek		10 ml.	3	3		3				
				1.0 ml.	3	3		3				
				0.1 ml.	3	3		3				
			.01	XXXX	3	0	1		1			
			.001	XXXXX	3	0	0			4,300		
				0.1 ml.								
/27	8/28 55564	S.F. Bay, 0 - 10		10 ml.	3	1	2	1	2			
				1.0 ml.	3	0	0					
				0.1 ml.	3	0	0					
			.01	XXXX	3	0	0					
			.001	XXXX	3	0	0			23		
				0.1 ml.								
/27	8/28 55565	S.F. Bay, 0 - 2		10 ml.	3	3		0	3			
				1.0 ml.	3	3		0	3			
				0.1 ml.	3	1	1	0	2			
			.01	XXXXX	3	0	1	0	0			
			.001	XXXXX	3	0	0			1,100		
				0.1 ml.								

ALL EXAMINATIONS ARE MADE IN ACCORDANCE WITH STANDARD METHODS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

REMARKS:

Scheduled distribution system samples, this report:

Number of samples ______

Number of samples with 3 or more tubes positive ______

Number of 10 ml tubes ______

Number of 10 ml tubes positive ______

Analyst P. Parsons

Reported by Morris Lipschuetz
Morris Lipschuetz

REPORT ON

BACTERIOLOGICAL EXAMINATION OF WATER

FROM THE LABORATORIES OF

BROWN AND CALDWELL

For Brown and Caldwell Consulting Engineers — Exam. No. 55566-55569

Report to Mr. Warren Uhte

Copies to

Date Reported 2/22/71

DATE TAKEN	DATE AND NO. OF EXAM.	SOURCE OF SAMPLE	BACTERIA PER ML. AGAR 35° C	EXAMINATION FOR COLIFORM ORGANISMS: PORTIONS EXAMINED		PRESUMPTIVE LACTOSE BROTH		CONFIRMED B.G.B.		COLIFORM ORGANISMS MOST PROBABLE NUMBER per 100 ml.	QUALITY AT TIME OF SAMPLING	
				Size	No.	24 Hr.	48 Hr.	24 Hr.	48 Hr.		Safe	Unsa
8/28	8/29 55566	S.F. Bay, 0 - 2		10 ml.	3		3	3				
				1.0 ml.	3		2	1	0			
				0.1 ml.	3		0					
			.01	~~10 ml.~~	3		0					
			.001	~~1.0 ml.~~	3		0			43		
				0.1 ml.								
8/28	8/29 55567	S.F. Bay, C		10 ml.	3		3	3				
				1.0 ml.	3		3	3				
				0.1 ml.	3		0					
			.01	~~10 ml.~~	3		0					
			.001	~~1.0 ml.~~	3		0			240		
				0.1 ml.								
8/29	8/31 55568	S. F. Bay, N3 - 6		10 ml.	3	0	3	2	1			
				1.0 ml.	3	0	1	1				
				0.1 ml.	3	0	0					
			.01	~~10 ml.~~	3	0	0					
			.001	~~1.0 ml.~~	3	0	0			43		
				0.1 ml.								
8/29	8/31 55569	S. F. Bay, 0 - 2		10 ml.	3	0	3	2	1			
				1.0 ml.	3	0	0					
				0.1 ml.	3	0	0					
			.01	~~10 ml.~~	3	0	0					
			.001	~~1.0 ml.~~	3	0	0			23		
				0.1 ml.								

ALL EXAMINATIONS ARE MADE IN ACCORDANCE WITH STANDARD METHODS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

REMARKS:

Scheduled distribution system samples, this report:

Number of samples ______

Number of samples with 3 or more tubes positive ______

Number of 10 ml tubes ______

Number of 10 ml tubes positive ______

Analyst PP P. Parsons

Reported by Morris Lipschuetz Morris Lipschuetz

REPORT ON

BACTERIOLOGICAL EXAMINATION OF WATER

FROM THE LABORATORIES OF

BROWN AND CALDWELL

For Brown and Caldwell Consulting Engineers

Exam. No. 55570-55571, 55587-55588

Report to Mr. Warren Uhte

Copies to

Date Reported 2/22/71

ATE AKEN	DATE AND NO. OF EXAM.	SOURCE OF SAMPLE	BACTERIA PER ML. AGAR 35° C	EXAMINATION FOR COLIFORM ORGANISMS						COLIFORM ORGANISMS MOST PROBABLE NUMBER per 100 ml.	QUALITY AT TIME OF SAMPLING	
				PORTIONS EXAMINED		PRESUMPTIVE LACTOSE BROTH		CONFIRMED B.G.B.				
				Size	No.	24 Hr.	48 Hr.	24 Hr.	48 Hr.		Safe	Unsafe
8/30	8/31 55570	S.F. Bay, #169, C		10 ml.	3	0	2	1	1			
				1.0 ml.	3	0	0					
				0.1 ml.	3	0	0					
			.01	XXXXX	3	0	0					
			.001	XXXXX	3	0	0			9		
				0.1 ml.								
8/30	8/31 55571	S. F. Bay, #71, 0-2		10 ml.	3	2	1	3				
				1.0 ml.	3	0	0					
				0.1 ml.	3	0	0					
			.01	XXXXX	3	0	0					
			.001	XXXXX	3	0	0			23		
				0.1 ml.								
8/31	9/01 55587	S. F. Bay, S2-7		10 ml.	3	1	2	1	1			
				1.0 ml.	3	0	1	1				
				0.1 ml.	3	0	0					
			.01	XXXX	3	0	0					
			.001	XXXX	3	0	0			15		
				0.1 ml.								
8/31	9/01 55588	S. F. Bay, 0-2		10 ml.	3	1	2	3				
				1.0 ml.	3	0	0					
				0.1 ml.	3	0	0					
			.01	XXXXX	3	0	0					
			.001	XXXXX	3	0	0			23		
				0.1 ml.								

ALL EXAMINATIONS ARE MADE IN ACCORDANCE WITH STANDARD METHODS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

REMARKS:

Scheduled distribution system samples, this report:

Number of samples ______

Number of samples with 3 or more tubes positive ______

Number of 10 ml tubes ______

Number of 10 ml tubes positive ______

Analyst PP P. Parsons

Reported by Morris Lipschuetz Morris Lipschuetz

REPORT ON

BACTERIOLOGICAL EXAMINATION OF WATER

FROM THE LABORATORIES OF

BROWN AND CALDWELL

For Brown and Caldwell Consulting Engineers — Exam. No. 55620-55621

Report to Mr. Warren Uhte

Copies to

Date Reported 2/22/71

DATE TAKEN	DATE AND NO. OF EXAM.	SOURCE OF SAMPLE	BACTERIA PER ML. AGAR 35° C	EXAMINATION FOR COLIFORM ORGANISMS: PORTIONS EXAMINED		PRESUMPTIVE LACTOSE BROTH		CONFIRMED B.G.B.		COLIFORM ORGANISMS MOST PROBABLE NUMBER per 100 ml.	QUALITY AT TIME OF SAMPLING	
				Size	No.	24 Hr.	48 Hr.	24 Hr.	48 Hr.		Safe	Unsa
9/01	9/02 55620	S. F. Bay, 0-2		10 ml.	3	1	2	0	2			
				1.0 ml.	3	0	1	0	0			
				0.1 ml.	3	0	0					
			.01	XXXX	3	0	0					
			.001	XXXX	3	0	0			9		
				0.1 ml.								
9/01	9/02 55621	S. F. Bay, 0-6		10 ml.	3	0	3	0	2			
				1.0 ml.	3	0	1	0	1			
				0.1 ml.	3	0	0					
			.01	XXXX	3	0	0					
			.001	XXXX	3	0	0			15		
				0.1 ml.								
				10 ml.								
				1.0 ml.								
				0.1 ml.								
				10 ml.								
				1.0 ml.								
				0.1 ml.								
				10 ml.								
				1.0 ml.								
				0.1 ml.								
				10 ml.								
				1.0 ml.								
				0.1 ml.								

ALL EXAMINATIONS ARE MADE IN ACCORDANCE WITH STANDARD METHODS OF THE AMERICAN PUBLIC HEALTH ASSOCIATION

REMARKS:

Scheduled distribution system samples, this report:

Number of samples ______

Number of samples with 3 or more tubes positive ______

Number of 10 ml tubes ______

Number of 10 ml tubes positive ______

PP

Analyst P. Parsons

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — **Date Collected** 8/26/70 - 8/30/70

Report to Brown and Caldwell, Consulting Engineers — **Date Received** 8/26/70 - 8/30/70

Copies to San Francisco Department of Public Works — **Date Reported** 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station C

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11798	Wednesday Aug. 26	Daylight lws	7.12	0.8	3.0	1.19	0.005	1.30			3.2
11859	Friday Aug. 26	Daylight lws	6.62	0.8	2.1	0.39	0.016	0.75			3.2
11889	Sunday Aug. 30	Daylight lws	6.77	0.9	3.1	0.53	0.010	0.70			2.1

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 9/1/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 9/1/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station N2-1

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11927	Tuesday Sept. 1	Daylight lws	5.88			0.49	0.008	2.55			6.2

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284
Report to Brown and Caldwell, Consulting Engineers
Copies to San Francisco Department of Public Works

Date Collected 8/26/70 - 9/1/70
Date Received 8/26/70 - 9/1/70
Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station N2-4

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11794	Wednesday Aug. 26	Daylight lws	7.03			1.09	0.004	0.85			3.2
11815	Thursday Aug. 27	Daylight lws	6.85			0.93	0.005	0.35			5.8
11857	Friday Aug. 28	Daylight lws	6.70			0.37	0.01	0.55			3.7
11864	Saturday Aug. 29	Daylight lws	6.64			2.93	0.005	0.90			3.4
11893	Sunday Aug. 30	Lower lws	6.89			0.90	0.005	0.80			2.8
11891	Sunday Aug. 30	Daylight lws	6.63			0.60	0.010	0.95			1.6
11917	Monday Aug. 31	Daylight lws	5.68			0.62	0.008	0.75			2.3
11928	Tuesday Sept. 1	Lower lws	6.59			0.42	0.008	0.20			3.6
11928	Tuesday Sept. 1	Daylight lws	5.69			0.54	0.008	1.55			4.4

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/27/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/27/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station N2-7

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11918	Monday Aug. 27	Daylight lws	6.05			0.58	0.008	0.95			2.3

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/20/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/20/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station N3-6

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11865	Saturday Aug. 20	Daylight lws	6.64	Nil	0.8	1.04	0.003	1.35			2.8

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284

Report to Brown and Caldwell, Consulting Engineers

Copies to San Francisco Department of Public Works

Date Collected 8/27/70

Date Received 8/27/70

Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station N7-6

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11814	Thursday Aug. 27	Daylight lws	6.95			0.79	0.004	0.10			4.2

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — **Date Collected** 8/26/70 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers — **Date Received** 8/26/70 - 9/1/70

Copies to San Francisco Department of Public Works — **Date Reported** 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station 0-2

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11793	Wednesday Aug. 26	Daylight lws	7.40	0.8	3.5	1.01	0.005	1.20			4.5
11813	Thursday Aug. 27	Daylight lws	6.90	1.1	1.5	0.40	0.004	0.95			4.5
11854	Friday Aug. 28	Daylight lws	6.95	0.6	2.9	0.64	0.010	0.35			2.8
11862	Saturday Aug. 29	Daylight lws	6.83	1.0	2.5	1.09	0.005	0.90			4.2
11886	Sunday Aug. 30	Daylight lws	6.99	1.0	4.8	0.93	0.005	0.80			3.6
11892	Sunday Aug. 30	Lower lws	6.70			0.45	0.005	1.00			4.4
11919	Monday Aug. 31	Daylight lws	6.12	Nil	0.6	0.60	0.012	0.50			3.2
11929	Tuesday Sept. 1	Daylight lws	6.45	0.3	0.7	0.59	0.012	0.70			5.6
11924	Tuesday Sept. 1	Lower lws	5.88			0.73	0.008	0.80			6.3

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/30/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/30/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station 0-4

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11890	Sunday Aug. 30	Daylight lws	6.78			0.54	0.008	0.80			2.2

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284

Report to Brown and Caldwell, Consulting Engineers

Copies to San Francisco Department of Public Works

Date Collected 8/28/70

Date Received 8/28/70

Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station 0-5

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11858	Friday Aug. 28		2.58			0.78	0.008	0.35			1.8

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 9/1/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 9/1/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station 0-6

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11930	Tuesday Sept. 1	Daylight lws	6.03	Nil	1.4	0.41	0.012	0.20			3.7

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/26 - 9/1/70
Report to Brown and Caldwell, Consulting Engineers — Date Received 8/26/ - 9/1/70
Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station 0-7

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11795	Wednesday Aug. 26	Daylight lws	7.36			0.57	0.005	0.95			2.4
11818	Thursday Aug. 27	Daylight lws	7.10			0.51	0.002	0.35			5.5
11855	Friday Aug. 28	Daylight lws	6.80			0.73	0.010	0.05			2.6
11863	Saturday Aug. 29	Daylight lws	6.65			1.07	0.004	0.65			2.6
11887	Sunday Aug. 30	Daylight lws	6.78			0.37	0.01	0.65			2.8
11894	Sunday Aug. 30	Lower lws	6.87				0.005	0.60			3.2
11920	Monday Aug. 31	Daylight lws	5.87			0.48	0.008	0.20			2.6
11931	Tuesday Sept. 1	Daylight lws	5.00			0.41	0.012	1.25			3.8
11925	Tuesday Aug. 31	Lower lws	4.16			0.68	0.018	1.05			5.3

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/27/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/27/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station 0-10

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11816	Thursday Aug. 27	Daylight lws	6.90	0.6	0.7	1.08	0.004	0.45			4.6

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 **Date Collected** 8/26 - 9/1/70

Report to Brown and Caldwell, Consulting Engineers **Date Received** 8/26 - 9/1/70

Copies to San Francisco Department of Public Works **Date Reported** 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station S2-4

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11796	Wednesday Aug. 26	Daylight lws	7.36			0.27	0.005	0.95			2.7
11817	Thursday Aug. 27	Daylight lws	6.82			0.41	0.003	0.35			6.0
11856	Friday Aug. 28	Daylight lws	6.80			1.04	0.008	0.15			3.0
11866	Saturday Aug. 29	Daylight lws	6.50			0.42	0.01	0.90			4.5
11895	Sunday Aug. 30	Lower lws	6.83			0.69	0.016	0.50			4.5
11888	Sunday Aug. 30	Daylight lws	6.66			0.37	0.010	0.70			2.7
11921	Monday Aug. 31	Daylight lws	5.60			0.55	0.012	0.55			2.7
11926	Tuesday Sept. 1	Lower lws	6.10			0.37	0.006	0.95			4.3
11932	Tuesday Sept. 1	Daylight lws	5.91			0.58	0.006	0.65			3.3

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 — Date Collected 8/31/70

Report to Brown and Caldwell, Consulting Engineers — Date Received 8/31/70

Copies to San Francisco Department of Public Works — Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station S2-7

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C 1 day (mg/l)	BOD, 20°C 5 days mg/l	Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
11922	Monday Aug. 31	Daylight lws	5.60	0.1	1.1	0.44	0.008	0.20			2.3

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284
Report to Brown and Caldwell, Consulting Engineers
Copies to San Francisco Department of Public Works

Date Collected 8/26/70
Date Received 8/26/70
Date Reported 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station S3-6

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C		Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
				1 day (mg/l)	5 days mg/l						
11867	Saturday Aug. 29	Daylight lws	6.71			1.01	0.006	1.05			3.2

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For San Francisco Water Pollution Control Plant Study, DPW 85,284 **Date Collected** 8/26/70
Report to Brown and Caldwell, Consulting Engineers **Date Received** 8/26/70
Copies to San Francisco Department of Public Works **Date Reported** 11/3/70

Southeast Water Pollution Control Plant - Receiving Waters Station S7-6

Analysis No.	Date	Time	Total dissolved oxygen (mg/l)	BOD, 20°C 1 day (mg/l)	BOD, 20°C 5 days mg/l	Nitrate (N) (mg/l)	Nitrite (N) (mg/l)	Ammonia (N) mg/l	Organic nitrogen (N) mg/l	Total nitrogen (N) mg/l	Turbidity JTU
11797	Wednesday Aug. 26	Daylight lws	7.50			0.96	0.004	0.80			3.2

CITY AND COUNTY OF SAN FRANCISCO

DEPT. OF
PUBLIC WORKS

REPORT ON

WATER POLLUTION CONTROL PLANTS

REPORT 1 – PHASE II

ALTERNATIVE TREATMENT PROCESSES FOR REDUCTIONS OF TURBIDITY, COLOR, FLOATABLES, GREASE AND SETTLEABLE MATTER

SEPTEMBER 1971

BROWN AND CALDWELL
CONSULTING ENGINEERS

SAN FRANCISCO

CITY AND COUNTY OF SAN FRANCISCO

REPORT ON

WATER POLLUTION CONTROL PLANTS

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PROJECT STAFF
BROWN AND CALDWELL

ENGINEERING

R. C. Bain, Jr.	F. J. Kersner
L. E. Birke, Jr.	J. T. Norgaard
E. de la Fuente	D. P. Norris
T. Googin	D. S. Parker
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DRAFTING

D. Aspinall	A. Lee
F. Bolton	R. Lee
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LABORATORY

S. Dunlap	T. Kondo
M. Eisenhauer	M. Lipschuetz
K. Hoag	J. Tyler
A. Jeong	E. Wilson
S. Kirby	D. Reinsch

FIELD WORK

R. Boswell	J. Morgal
W. Gomez	O. O'Neal
J. Kardash	R. Septon
J. Lawson	J. Uhte
G. Mah	

REPORT PREPARATION

M. A. Earl	A. H. Morilla
C. Healy	C. S. Reser
M. Warman	R. Cavalier

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September 1, 1971

F265A

Mr. S.M. Tatarian, Director
Department of Public Works
City and County of San Francisco
260 City Hall
San Francisco, CA 94102

WATER POLLUTION CONTROL PLANTS - REPORT 1, PHASE II

In accordance with our agreement dated June 10, 1970, we are submitting Report 1, Phase II on the work covered by our agreement. This report covers alternative treatment processes required to meet various levels of effluent quality with regard to turbidity, color, floatables, grease and settleable solids at the City's water pollution control plants as prescribed by the San Francisco Bay Regional Water Quality Control Board.

We will be happy to meet with you or your staff to discuss our report at any time you may desire.

BROWN AND CALDWELL

Frank J. Kersnar

Frank J. Kersnar

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BROWN AND CALDWELL 66 MINT STREET SAN FRANCISCO CALIFORNIA 94103 (415) 982-2442

CONTENTS

CHAPTER 1

INTRODUCTION

By resolution Nos. 69-44 and 70-17, the San Francisco Bay Regional Water Quality Control Board required the City and County of San Francisco to submit an engineering report on the Southeast and North Point water pollution control plants evaluating the requirements and costs of producing effluents of specified characteristics. The resolutions state in part:

"The discharger is required to submit the following reports to this Board on or before November 30, 1969:

A firm and detailed time schedule for the preparation of a preliminary engineering report and cost estimates for facilities needed to comply with the above requirements for floatables, turbidity, discoloration and settleable matter. For purposes of said report, the discharger shall use the following numerical ranges:

Reduction in water clarity:
- 5 to 30% in 90% of the determination made on any day in the area of greatest turbidity.

Floatables in the receiving water at any place:
- 10 to 50 mg/sqaure meter.

Grease in the effluent:
- 5 to 30 mg/1

Settleable matter in the effluent:
- In any grab sample:
  1. The arithmetic average of any six or more samples collected on any day - 0.5 ml/1/hr maximum.
  2. 80% of all individual samples collected during maximum flow over any 30-day period - 0.4 ml/1/hr maximum.
- Any sample - 1.0 ml/1/hr maximum.

...The Board expects the discharger to report on the type of facilities needed and the cost of complying with various numerical values within the above ranges..."

To fulfill these requirements, the City and County of San Francisco, acting through its Department of Public Works, engaged the firm of Brown and Caldwell to prepare the necessary engineering reports evaluating present plant performance and developing improvements necessary to comply with the above listed numerical limits. Although not required by the Regional Board, the city included the Richmond-Sunset water pollution control plant in the study.

Under the terms of an agreement for engineering services dated June 10, 1970, the required work is divided into two phases. Phase I involves a determination of existing conditions and Phase II involves an evaluation of process and operational changes. Separate reports are required for the two phases.

Objectives and Scope of Phase II Study

The objective of the Phase II study is to evaluate process and operational changes recommended for investigation by Report 2, Phase I and to estimate capital and operating costs at each of the City's three water pollution control plants for facilities required to attain four levels of effluent and receiving water quality. At least one of these four levels will comply with the objectives, requirements and goals of the San Francisco Bay Regional Water Quality Control Board. Under the terms of the agreement for engineering services, work to be performed included the following:

1. Evaluation of present plant operations and processes to determine where in-plant improvements may be made, where operations may be modified and where source controls may be necessary.
2. Evaluation of all presently planned plant process and operation improvements.
3. Evaluation, by in-plant pilot plant studies, of the effect of additional treatment processes deemed necessary to supplement existing facilities.
4. Determination of incremental capital and maintenance costs for all process and operational changes.
5. Preparation of a final report for PhaseII presenting and discussing information developed in this phase of the investigation and including a complete description of each alternative for each plant.

Abbreviations used in this report are defined in Appendix B.

Field and Laboratory Work

Field and laboratory work was concerned primarily with the following activities:

1. Operation of in-plant pilot studies at the North Point water pollution control plant.
2. Determination of composition of influent, in-plant process and effluent for various modes of operation of the pilot plant. Most samples were composited automatically in relation to flow and stored in chilled containers. Field determinations were made for some parameters immediately after samples were collected. Analyses of samples were made in several specialized laboratories.

Office Work

Office work was concerned with the following principal activities:

1. Review of treatment plant operational data gathered as part of the determination of existing conditions and present modes of operation in each of the City's water pollution control plants.
2. Reviews of presently planned plant process and operational improvements. Descriptions, charts and reports relating to these improvements were furnished by the staff of the Sanitary Engineering Division of the Bureau of Engineering.
3. Determination of alternative treatment processes required for complying with objectives, requirements and goals of Regional Board.
4. Estimation of construction and operational costs for alternative treatment processes.
5. Preparation of final report.

Information and Data Made Available

Existing reports, descriptions and statistical information relating to the City's water pollution control plants were furnished by the staff of the Division of Sanitary Engineering of the Bureau of Engineering and of the Sewage Treatment Division of the Bureau of Water Pollution Control of the City's Department of Public Works.

Progress Reports

Written reports on the progress of the study were made monthly to the Director of Public Works. Additionally, periodic meetings were held with the staff of the Sanitary Engineering Division to discuss the study progress and preliminary findings.

Acknowledgments

For their assistance during the study, we wish to express our appreciation to A. O. Friedland, R. T. Cockburn and W. R. Giessner and other members of the staff of the Division of Sanitary Engineering of the Bureau of Engineering and to K. Fraschina, J. H. Crafts, A. E. Bagot, W. C. Jow, L. T. Yew, R. Loucks, P. Shinn, N. Lago, A. Benas, C. Zern and D. Mc Nulty of the Sewage Treatment Division of the Bureau of Water Pollution Control and other personnel of the Sewage Treatment Division of the Bureau of Water Pollution Control.

CHAPTER 2

EVALUATION OF PRESENT PLANT OPERATIONS AND PROCESSES

The tributary areas of the three existing water pollution control plants are all served by combined sewerage systems. The plants provide primary treatment and problems associated with flows from combined sewers are common to all three. Solids from the North Point plant are pumped to the Southeast plant for treatment and disposal and, therefore, problems associated with the solids treatment process are evident at only the Southeast and Richmond-Sunset plants.

Most of the process equipment in each plant is operated manually. Although manual operation often results in maximum flexibility, it also results in inconsistent operation which can, and occasionally does, cause upsets in the treatment process with resulting treatment inefficiency. Automatic controls, when properly applied, can assure uniform reactions to process variables and, if necessary, can be provided with manual adjustment for flexibility. Such controls will make it possible to reallocate manpower from routine manual operation functions to preventive maintenance and repair functions.

All three plants are at least twenty years old. In many instances equipment and structures have deteriorated to conditions normally attributed to much longer periods of service. This has resulted largely from the lack of adequate manpower and the requirements of day-to-day manual operation which in turn have resulted in a breakdown maintenance philosophy and the absence of a thorough program of preventive maintenance, adequate stockpiling of essential spare parts and systematic use of structure and equipment corrosion protection coatings. Aggravating the problem are the facts that accessibility for operation and maintenance is limited in some areas and that material handling techniques are inadequate in other areas. Major revisions and remodeling will be required to bring each plant to an operating and equipment status level comparable to a modern plant designed for maximum reliability and efficiency.

The large wet weather sewage flows entering the North Point plant overload the plant's facilities and cause upsets in the treatment process. Major revisions will be required, therefore, to assure treatment efficiency and reliability for flows up to and including 200 mgd. In addition, revisions in process units will be required to obtain maximum efficiency in treatment of dry weather flows.

NORTH POINT WATER POLLUTION CONTROL PLANT

The North Point Water Pollution Control Plant is located in an area which creates greater than normal problems associated with odor and noise. In general, structures and equipment at the North Point plant show less evidence of deterioration than the structures and equipment at the other two plants principally because sludge handling facilities are minimal at this plant.

Emergency Bypass. Under PWWF conditions the capacity of the incoming sewer exceeds the hydraulic capacity of the plant and throttling of the incoming flow is required. At present, approximately six minutes is required to close the inlet isolation or throttling sluice gates whenever a power failure occurs or whenever the influent pumps cease operating for any reason. Because of this slow time of closure, sewage occasionally floods the pump sump area and could, when operating under PWWF conditions, flood the screening and grit removal areas before complete shutdown could be achieved. To eliminate this flodding problem, control of the influent sluice gates should be such that the gates will close from any operating position in about ten seconds.

To avoid flooding, it was observed that some members of the operating staff either begin to throttle flow into the plant at levels below the plant's hydraulic capacity to assure a rapid gate closure in case of emergency or operate the influent pump sump at a lower

elevation to assure the availability of additional storage volume. Both these modes of operation result, however, in the plant operating at less than maximum capacity and, therefore, at less than peak efficiency.

Screenings. The bar screens at the North Point plant are the last of the original plant screens still in service at any of the three plants. The screens are generally acceptable for the load imposed on them during dry weather, but are inadequate for loads which occur during wet weather flows. During these periods, the screens often clog and require extra manpower to keep in operation. To assist the rake in removal of debris accumulated on the screens, operators use long poles to manually help the rake to engage the rack. Wet weather throttling of flow into the plant sometimes aggravates the problems in that heavy material is jetted under the coarse bar racks directly onto the bar screens. At times these problems have caused the plant to be at least partially bypassed.

Although maintaining the bar screens in operation is a troublesome and time consuming task during periods of wet weather flow, the handling of the screenings, once they are removed from the flow, is a time consuming operation at all times. The screenings are dumped into storage buckets which must be manually moved to a pick-up opening, lifted to a dump truck, emptied and moved back to the screenings area. Once-a-week cleaning of the buckets is required to control odors. Screenings occasionally are kept in the open dump truck for many hours before being hauled away. Improvement of the screenings operation would reduce the number of man hours required and would also partially alleviate the ventilation problem in the pretreatment structure.

Grit Removal and Disposal. As presently operated, the grit chambers do a fair job of collecting and removing grit from sewage flows up to about 160 mgd. The major problem with the grit removal and disposal system is the grit dewatering equipment. Deterioration of the equipment and excessive inlet velocities make for an inefficient dewatering operation with the result that most of the grit is returned to the plant influent with the overflow from the unit. The grit washers are still original equipment.

While the major cause for inefficiency in the operation of the grit disposal system is the poorly functioning dewatering unit, removing grit from the grit chamber by screw conveyor and then re-slurrying it to flush it to the grit sump also is inefficient. The screw conveyors do an excellent dewatering job, probably as good as the reciprocating rake washers, although they may not completely separate the organic and inorganic material. Some means should be provided to transport the relatively dry grit from the screw conveyor directly to the storage bins. An improvement in grit removal efficiency would result with this change in operation.

Influent Pumping. One of the major factors affecting treatment efficiency at the North Point plant are the two large sumps preceding the influent pumping units. Detention time in these sumps, having a combined volume of 900,000 gallons, can be sufficient to create high sulfide conditions in the pump discharge strusture and to cause gassing of sludge in the sedimentation tanks. The consequence of this is carryover of solids with the plant effluent. Scum also accumulates on the surface of the sumps. Periodic removal of this scum is required to control odors. Settling of heavier solids in the sumps requires dewatering of the sumps and manual removal of this material. Although scrapers were provided during initial construction of the plant for removal of material settling in the sumps, these were out of service for many years before being recently replaced.

Cleaning and maintenance of the sumps to assure proper operation is required approximately once a month. Additionally, since the sumps are kept at a lower water surface elevation than would be necessary for operation with smaller compact sumps, power requirements for pumping are increased substantially.

To achieve proper operation of the influent pumping system will require reconstruction of the sumps to reduce their volume. In conjunction with this, the influent pumps will have to be changed to operate at variable speed and a control system installed to maintain proper water surface elevations in the inlet channels to the pumps.

The existing pump discharge structure is inadequate in that control of odors from the structure is not provided and isolation of the flap gates on the pump discharge lines is difficult to achieve. Both deficiencies should be eliminated as part of a general modernization program.

Preaeration and Primary Sedimentation. Distribution of flow to the six combination preaeration-sedimentation tanks seems to be uniform with no obvious excessive loading of any single tank. Because of the difficulty of keeping the air diffusion plates clean, distribution of air in the preaeration tanks is poor. The resulting loss of efficiency in preaeration and the long detention time in the sedimentation tanks under conditions of less than ADWF sometimes causes septic conditions with sonsequent gassing in the sludge. In addition, because sludge is moved to the effluent end of the tank and therefore is detained in the tank for an unnecessarily long period, the problem of gassing sludge can be further aggravated. This situation can result in an excessive carryover of solids with the effluent.

The present scum skimming operation requires a great deal of maintenance. Plant effluent is utilized for the water sprays and, although it is screened through a 40 mesh filter media, causes clogging of the spray nozzles after only short periods of service. The continuous cleaning required to assure efficient nozzle operation is often not provided. The scum removing tipping troughs are manually operated and every time the operator performing the skimming function does not do the job properly, the troughs either draw too much liquid or do not remove all the scum which has accumulated.

The effluent troughs are a source of odorous and potentially corrosive gases in the preaeration-sedimentation structure. These gases are released to the atmosphere when the tank effluent flows over the trough V-notch weirs. Also, any floating scum or sludge which is buoyed to the surface of the tank is carried over with the effluent.

Major improvements are required in the preaeration-sedimentation process to achieve the maximum efficiency in operation and to reduce maintenance and operational manpower requirements. These improvements include (1) changes in air diffusion equipment in the preaeration tanks, (2) revision of sludge collecting equipment so that sludge detention time in the tanks is reduced, (3) provision of air sprays for scum skimming, (4) provision of automatic scum removal equipment, and (5) provision of sub-surface effluent collectors to minimize odor production and to prevent carryover of floating solids with the effluent.

Chlorination. Chlorination equipment at the North Point plant is adequate for present sewage flows. If maximum flows are increased to 200 mgd, additional evaporators and chlorinators will be required to provide adequate standby capacity. Additional equipment will also be required if chlorination of the sludge to minimize decomposition in the force main to the Southeast plant is practiced.

The time of travel of chlorine solution between the injectors and diffusers is long limiting the rate of response to changes in pumped flow and causing extra chlorine to be used by the breakpoint chlorination of the effluent used by the injector. Instantaneous mixing of the chlorine solution with the effluent is also inadequate.

Effluent Disposal. Present disposal of effluent through outfalls terminating in shallow water at Piers 33 and 35 is not satisfactory. A properly designed submarine outfall terminating in deep water in San Francisco Bay will be required to assure compliance with Regional Board requirements.

Solids Treatment

All sludge and scum removed during the treatment process at North Point is pumped to the Southeast plant for treatment and disposal. Consequently, the problems associated with solids treatment are not present. Solids handling is nevertheless one of the major operational problems.

Sludge and Scum Removal. Sludge removed from the sedimentation tanks is pumped twice before it enters the disposal force main. This practice results in excessive use of manpower and of electrical energy and gives rise to odors in areas surrounding the sludge storage pumps. Direct pumping from the sedimentation tanks with automatic control of sludge quantity and quality would reduce both manpower and energy requirements and would eliminate odors associated with the storage sumps. Scum removed from the sedimentation tanks is collected in two sumps and then pumped directly into the disposal force main.

Solids Disposal. As previously noted, all sludge removed at North Point is pumped to the Southeast plant for disposal. The sludge is

discharged through a single 10-in. force main and consequently solids removal from the North Point plant is entirely dependent on the integrity of this line. Long periods of shutdown due to clogging or rupture of the line can completely disrupt operation of the North Point plant. Although some sludge storage capacity is available in the sedimentation tanks, any major shutdown of the sludge force main results in gross carryover of solids with the plant effluent. To insure continued compliance with the requirements of the Regional Board, a parallel sludge force main should be installed between the two plants.

Septic conditions which develop in the force main make the handling of sludge from the North Point plant extremely odoriferous at the Southeast plant. To alleviate this problem, some method of retarding bacterial action should be adopted. Chlorine demand experiments made as a part of this study indicate that chlorine applied at the rate of about 500 lbs per day will successfully inhibit bacterial action for the four hour detention time of the sludge in the force main.

Supplemental Facilities

Supplemental facilities at the North Point plant, except for the secondary systems of ventilation, power and control, and No. 2 water, appear to be adequate.

Administration. Office, laboratory, control room, lunch room and washroom space is sufficient to support the manpower presently working within the plant. The space also seems to be adequate to accommodate additional personnel which may be required at the plant.

Maintenance. Existing maintenance facilities, while adequate in size, lack a full complement of machine tools and equipment. although space has been allocated for the maintenance and repair of electrical equipment no air conditioning is provided and provisions for instrumentation repair are minimal.

Ventilation. Ventilation and odor control are a major problem at the North Point plant. Some critical areas have inadequate forced ventilation, while others have deteriorating duct work. Condensation in the preaeration-sedimentation buildings during the colder winter months is causing severe corrosion problems. Odor control, utilizing masking agents, apparently is successful in suppressing objectionable odors away from the plant since few odor complaints are received. A more positive solution, however, would be to install a system involving scrubbing of the ventilation air before discharge to the atmosphere. Ventilation systems should be revised as required to provide powered intake and exhaust fans to all areas. The systems should be designed to maintain a slightly negative pressure in all areas where odors may be produced and a slightly positive pressure in all other areas. Obviously, severely corroded duct work should be replaced.

Power and Control. Major power switchgear and distribution is good. Motor control centers in the pretreatment building and the sludge control area of the preaeration-sedimentation buildings are exposed to corrosive atmospheres and are therefore vulnerable to deterioration. These centers should be isolated with the rooms provided with filtered air to maintain a dust-free atmosphere. In areas with exposed sewage surfaces, equipment and apparatus should be of the sparkless type.

Manual operation and decentralized control systems presently require that the pretreatment and sludge control areas be manned 24 hours a day. If certain systems are automated and centralized control is provided, personnel presently assigned to these duties could be reassigned. Additionally, automatic control and centralized supervisions will undoubtedly result in an overall increase in treatment efficiency. Although the plant does possess an intercommunication paging and telephone system the lack of adequate communication between key instruments and the main recording and control panel wastes manhours.

No standby power facilities are available to keep essential equipment in service during a power failure. Influent gates are designed to close on existing water pressure under such a condition.

Water Systems. The capacity of the No.2 water system is limited by the long 10-inch suction line. The capacity of the system can be increased by relocating the No. 2 water pumps from the pretreatment structure to the sedimentation gallery near the maintenance building.

Treatment Plant Personnel

Under the existing system of manual operation, the present class and operating personnel at the North Point plant seem to be adequate for maintaining the routine daily tasks involved and providing some maintenance and repair of equipment. In 1969-70 almost 10 percent of the total wages paid out at the three plants resulted from vacation and holiday relief, sick leave relief, premium pay and other similar costs. In addition to the operation personnel listed in Report 1 of Phase I, the North Point plant is provided with a machinist, three-fifths of the time of a gardener, and the full time of an electrician.

No manpower seems to be available for a continuous program of preventive maintenance and repair. If the improvements previously noted, including automation of the screenings, grit and solids handling operations, are undertaken, we believe that reassignment of operating personnel to preventive maintenance will be possible. This switch in personnel follows the trend summarized by Garber[1] when he concluded that the need to optimize quality of treatment will mean an increased emphasis on repair and maintenance functions with a resultant increase in maintenance personnel as compared to operating personnel.

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

The Richmond-Sunset plant, completed in 1939, is the oldest of the City's three plants. Major remodeling and revisions of the plant have been undertaken to maintain it in an operable condition.

Sewage Treatment

The hydraulic capacity of the Richmond-Sunset plant is adequate to handle flows up to 70 mgd. Head losses through the plant are excessive, creating potential odor problems at the points of free fall over weirs. Sufficient head, however, still appears to be available to incorporate additional treatment facilities and a submarine ocean outfall at ADWF without resorting to pumping, although it will be necessary to provide effluent pumping to assure discharge of PWWF through the outfall.

Sunset Pumping Station. The Sunset pumping station, which is automatically controlled, requires a minimum of operator attention and maintenance, although the cleaning and maintenance of the coarse screens immediately upstream of the pump suctions is a problem. The existing pump control system permits the removal of the maximum amount of sewage flow from the Mile Rock sewer during periods of PWWF.

Emergency Bypass. Operation of the overflow weir at the plant headworks structure is such that at times flows equal to the hydraulic capacity of the plant are not conveyed to the plant even though combined sewage is overflowing to the Mile Rock outfall. Excessive bar screen losses can cause overflows to occur at much lower flows. Flow controls should be revised to insure that the plant operates at its maximum capacity before bypassing occurs. This involves installation of automatically controlled sluice gates to provide positive mechanical action. The overflow weir, set at a higher elevation, would be retained to operate in case of malfunction of the sluice gate system.

Screenings. The new coarse rack and automatic bar screen facilities should be capable of providing adequate removal of gross solids once construction is complete. Velocities through the screens should be reduced to obtain the best operation. Although screenings are lifted by the rakes more than is normally desirable, this feature of the screens permits screenings to drop directly onto a single relatively flat conveyor belt for transportation to the storage bins. More than normal wear of sprockets, chains and rakes can be expected, however.

Grit Removal and Disposal. The grit removal and disposal system is presently being revised. It is expected that when the new system goes into operation, grit removal efficiencies will improve. Efficiencies could be further improved if the material removed from the grit tanks were pumped directly to cyclonic separators rather than to a separate concentration tank. Grit pumps must have sufficient head to provide separators with the energy required to maintain cyclonic separation under all conditions.

Revisions to the grit tanks should be made to eliminate the free fall over the tank discharge weir and to assure proper distribution of flow to each tank regardless of the number of bar screens in service. It is presumed that with proper controls the grit tanks could be used for regulating velocity of flow through the bar screens. Isolation and inlet gates for the bar screens and grit tanks should be revised so that free surface flow is achieved thereby eliminating any tendency toward scum accumulation.

Primary Sedimentation. Flow distribution to the five sedimentation tanks appears to be satisfactory. The effluent troughs are a source of odorous and potentially corrosive gases in the sedimentation tank area. These gases are released to the atmosphere when the tank effluent flows over the V-notch weirs. Sludge collection seems to be satisfactory with minimum retention time of the solids in the tanks.

Scum skimming with both water sprays and return flights seems to be satisfactory although the difficulty of maintaining the water sprays results in their somewhat irregular operation. The rotating skimmers appear to be operating adequately, although solids have been seen to pass under their baffle and at times they are operated too frequently or for too long a time resulting in excess water being drawn into the solids handling system.

In general, operation of the sedimentation tanks at the Richmond-Sunset plant appears to be satisfactory. To achieve maximum efficiency, however, revisions to the effluent troughs should be made to minimize releases of gases and to prevent carryover of floating solids. Revisions should also be made to the scum removal system to provide shorter skimmers and automatic operation so that maximum qualtities of scum are removed with a minimum of water being carried over.

Chlorination. Chlorination equipment at the Richmond-Sunset plant is fairly new and in good condition. The only equipment presently not in operating condition is the chlorine residual analyser, a unit that requires too much maintenance for the results achieved when operating on a primary effluent. Postchlorination mixing is achieved primarily by the hydraulic jump at the inlet to the mixing chamber, although the flash mixer is also operated in the chamber helping to maintain uniform dispersion. At the present time no prechlorination facilities exist. Facilities for prechlorination should be installed as soon as practicable to assist in odor control and for improvement of the treatment process by oxidation. The time of travel between the bypass chlorination injector and diffuser is long and limits the rate of response to changes of flow. This could result at time in the release of significant quantities of unchlorinated sewage and at other times in over chlorination. The system should be changed, therefore, to one with quick response.

Effluent Disposal. The Mile Rock outfall, which presently transports the effluent from the Richmond-Sunset plant to the ocean, discharges in the tidal zone. The disposal conditions are such that most of the discharge requirements cannot be met. To insure compliance with requirements of the Regional Board, a deep water submarine outfall will have to be constructed.

Solids Treatment

Solids treatment at the Richmond-Sunset plant is by anaerobic digestion and vacuum filtration. Sludge cake is used in Golden Gate Park for fill and soil stabilization. Some return of solids from these processes to the primary treatment units occurs. Under certain operation conditions this return affects the efficiency of the treatment process.

Sludge and Scum Removal. Sludge and scum are removed manually from the Sedimentation tanks. The material flows by gravity from the collection hoppers and troughs to decanting tanks. The gravity lines are subject to frequent clogging and backflushing is required at least once a day. The backwashing, if not carefully regulated, causes solids in the sedimentation tanks to be stirred up and to rise to the surface. A new system utilizing a pipeline cleaning 'pig' is being worked on to reduce the frequency of backflushing these lines. Return of supernatant from the decanting tanks to the sedimentation tank influent adds further to the problem since solids which already have been removed must go through the entire cycle again. In addition, manual removal is erratic because in practice each operator individually determines the requirements for backflushing

and for return of supernatant and pumping of solids from the decanting tanks.

Although it is believed that manual operation assures pumping of the most concentrated sludge to the digesters, this does not seem to be the case. Average solids concentrations of between 2 and 2.5 percent as reported in Report 1, Phase I are substantially less than can be obtained by automatically controlled pumping directly from sedimentation tanks. For example, plants utilizing such systems, such as the Central Contra Costa Sanitary District plant[2] and the Municipality of Metropolitan Seattle West Point plant[3] consistently remove sludge from the sedimentation tanks at concentrations in excess of 4 percent. Because of the more efficient solids removal system, the Central Contra Costa plant also maintains considerably lower settleable solids in the effluent than is achieved at the Richmond-Sunset plant. Improvements to the sludge and scum removal system should be made to improve performance efficiency and to obtain denser sludge. In addition, reallocation of manpower will be possible through elimination of the long gravity lines and through automation of the system.

Solids Pumping to Digesters. Solids are pumped intermittently from the decanting tanks to the digesters by centrifugal pumps. The raw solids are discharged directly to digesters with no provision for in-line measurement of flow or for pre-heating by mixing it with digesting circulated sludge from the digester. Raw sludge quantities are determined from the decanting tank volumetric measurements recorded by the operators during each pumping cycle. Because of limited head capacity of the pumps and the excessive grease build-up in the force mains it is often necessary to operate the pumps in series. Operation of the pumping system is manually controlled. Improvements to the sludge pumping and piping system should be made to permit (1) mixing of the raw solids with digesting sludge prior to discharge to the digester, (2) intermittent circulation of digesting sludge through the pumps to assist keeping the pipelines clean, and (3) automatic operation of the pumps.

Solids Digestion. The digesters at the Richmond-Sunset plant are lightly loaded and at present solids concentrations provide a liquid detention time of over 30 days. The fixed cover of the primary digester is showing signs of deterioration with consequent gas leakage. The gas holding cover of the secondary digester is in similar condition, even though its surfaces were coated about seven years ago. Routine probing indicates that both digesters may have a considerable build-up of inorganic solids. A comparison[4] of velocity gradients within the digesters indicates that the mixing systems are functioning at about 1/3 to 1/2 of the rate necessary to maintain the digesters free of scum accumulation and grit deposits.

Because the primary digester has a fixed cover and the liquid level in the secondary digester is held relatively constant, either supernatant or digested sludge is withdrawn each time raw sludge is added to the digesters. Since operation of the sludge disposal facilities is on an intermittent basis, the elutriation tank overflow operates continuously and often carries over significant quantities of solids to the influent of the plant

The digester area has been modified many times during the period the plant has been in operation with the result that piping and equipment is unnecessarily complicated. Abandoned piping and equipment have largely been left in their original position making maintenance and operation in the area difficult. Inadequate points of discharge and suction are provided for circulating sludge with the consequence that supernatant removal and sampling piping is sometimes utilized for this purpose. No metering devices are provided to measure the flow of digested sludge or of supernatant to the solids conditioning and disposal system. Revisions to piping and equipment should be made to simplify operation and to permit adequate maintenance in the area.

Gas produced during the digestion process is used for mixing and as fuel for the plant steam boilers. The gas handling equipment in the boiler area is in an extremely hazardous location and should be relocated to an isolated area. The capacity of the gas mixing equipment appears to be somewhat deficient for the digester capacity. The waste gas burner is adequate for the quantity of gas produced.

Although there are some deficiencies in the digestion system, as noted above, performance of the digesters is excellent. During the week of sampling, results of which are included in Report 1, Phase I, reduction in volatile matter

was about 70 percent. Gas production was also high being almost 200,000 cu ft per day.

Solids Conditioning and Disposal. As presently operated, the elutriation tanks provide conditioning and storage for the digested sludge prior to filtering and disposal. The tanks, however, have limited solids storage capacity and no liquid storage capacity because the No. 2 water is always on. Consequently, overflow to the plant influent is constantly occurring. Adequate capacity to store digested sludge without continuous liquid overflow should be provided. With this storage, the elutriation system could be abandoned and chemicals used totally for conditioning of the sludge before filtering. Although elutriation probably is the least expensive method of sludge conditioning, the process sometimes produces an overflow containing solids that are septic and is usually a source of odorous and potentially corrosive gases. Guidelines published by the Environmental Protection Agency[5] recommend that elutriation may not be used for sludge conditioning.

The existing solids and chemical handling facilities and filtration equipment have adequate capacity to filter all solids produced in the plant while operating only four to five days per week. If chemical conditioning of sludge is provided rather than elutriation, additional chemical storage and new chemical and solids feed equipment will be required.

Sludge cake is used for filling and soil stabilization in Golden Gate Park. The public is generally not aware that the City and County of San Francisco has been using water reclaimed from sewage for irrigation and sludge cake for soil stabilization in the park for over twenty years. This commendable program is undoubtedly a large factor in the ability to maintain the park in the excellent condition enjoyed by so many people. Limited amounts of sludge cake are made available to the public on a first-come first-served basis.

Supplemental Facilities

Supplemental facilities require more modification at the Richmond-Sunset plant than at the other two plants.

Administration. Because of the area used for sludge filtering on the ground floor area of the administration building, space available for office, laboratory, reception, lunch room and washroom facilities is limited. The area in which power distribution equipment is located is too small to permit proper maintenance. Access to the boiler room is poor creating potentially dangerous conditions. In addition, the location of gas handling equipment in the boiler room is hazardous and this equipment should be located elsewhere. The elutriation system, located in the basement of the building, is a source of odors which with the existing ventilation system, are difficult to exclude from the remainder of the building.

Maintenance. Maintenance facilities are housed in the administration building and in a separate building between the administration and sedimentation buildings. In general, the space and the tools and equipment provided appear to be adequate for maintenance requirements at the plant. Storage space seems to be limited.

Ventilation. Ventilation systems throughout the plant employ gravity supply and powered exhaust. These systems do not function properly and should be revised as required to provide powered intake and exhaust fans to all areas. The system should be designed to maintain a slightly negative pressure in all areas where odors may be produced and a slightly positive pressure in all other areas. A system should be installed for scrubbing ventilation air from odorous areas before discharge to the atmosphere.

Power and Control. Major power switchgear and distribution equipment is old and should be thoroughly inspected and replaced where found obsolete or unsafe by present standards. Motor control centers are scattered throughout the plant and are generally in atmospheres conducive to deterioration. These centers should be isolated with the rooms provided with filtered air to maintain a dust free atmosphere. In areas with exposed sewage surfaces equipment and apparatus should be of the sparkless type.

Manual operation and decentralized control results in extra operation manpower to assure that all processes receive sufficient attention at all times. If certain systems are automated and centralized control is provided,

operation manpower requirements during the evening and early morning shifts could be reallocated to maintenance. Lack of any adequate communication system also wastes manhours.

No standby power facilites are available to keep essential equipment in service during a power failure. Influent gates are designed to close under such conditions.

Water Systems. The hydropneumatic tank on the No. 2 water system is inoperative because of insufficient compressed air. This results in the continuous operation of one of the No. 2 water pumps under practically shutoff head conditions. This operation shortens the life of the pump and requires additional maintenance and power. The No. 1 water system is adequate. The lack of screening on the No. 3 water system results in frequent clogging of the water sprays in the sedimentation tank skimming system. If water sprays and elutriation wash water uses are eliminated, the existing No. 3 system could be used for chlorine injection. This would mean a major reduction in the use of City water, which, although not metered or billed, is still an expense to the City taxpayers. The use of injectors near the point of application will assure that excessive chlorine is not used to meet the instantaneous demand of No. 3 injector water.

Steam Cleaning. With the installation of the new permanent cleaner in the pretreatment building, the stream cleaning system is considered adequate for that area, however, no steam cleaning facilities are provided for either the sedimentation or digestion areas.

Treatment Plant Personnel

Under the existing system of manual operation the present class and number of operating personnel at the Richmond-Sunset plant seem to be adequate to perform the routine weekly and daily tasks and to provide emergency maintenance and repair. In 1969-70 almost 10 percent of the total wages paid out at all three plants resulted from vacation and holiday relief, sick leave relief, premium pay and other similar costs. In addition to the operation personnel listed in Report 1 of Phase I, the Richmond-Sunset plant is provided with a machinist, two-fifths of the time of a gardener, and one-half of the time of an electrician.

No manpower seems to be available for a continuous program of preventive maintenance and repair. If the improvements previously noted, including automation of operations, elemination of the elutriation system, and centralization of plant controls, are undertaken, we believe that reassignment of operating personnel to preventive maintenance will be possible.

SOUTHEAST WATER POLLUTION CONTROL PLANT

The Southeast plant provides treatment for sewage collected within its tributary area and for sludge from both the Southeast and North Point plants. The interrelationship of the processes for treatment of sewage and of sludge create problems in operation and affect the quality of the effluent produced.

Sewage Treatment

Sewage treatment facilities at the Southeast plant have been extensively modified from those originally provided. These modifications have not always resulted in improved treatment efficiency and others will be required to obtain the best effluent possible at the plant.

Emergency Bypass. The isolation gates on the influent structure are operated by a high pressure hydraulic oil system. This system provides rapid and positive closure whenever required by plant malfunction or power failure, but needs overhaul for almost each time the gates are closed they must be manually jacked open.

Screenings. Large floating debris which is retained on the coarse racks is removed manually by lifting the racks from the floor to an operating platform almost 20 ft above the channel bottom. This operation is a difficult one but vital to the reliable operation of the plant.

The automatic bar screens are located in an area of high turbulence just upstream from the suction sumps of the raw sewage pumps. Because of the high turbulence, much of the debris which would otherwise be retained on the screens is washed through the racks. Material retained on the bar screens is lifted 57 ft to

the headwork building roof by the cleaning rakes. This lift is considerably greater than is desirable and will undoubtedly result in excessive wear of the equipment. The high lift also results in the screenings often dropping off of the rakes. Poor wiping action results in much of the screenings not being completely removed by the wipers. The material thus retained is returned to the flow on the downstream side of the screen and washed off.

Material removed by the wiper is discharged to a conveyor belt system which transports it to a storage bin. The conveyor system has an upward bend in its track with the result that the belt runs off and above many of its guides and assumes a convex rather than a concave shape. As a result, some of the material falls from the conveyor system and causes an unsightly condition.

Influent Pumping. The influent pumping system at the Southeast plant provides variable speed pumping. The suction sump has been revised to minimum size and, therefore, the problems associated with a large sump, as at the North Point plant, are not evident at the Southeast plant. The system has the flexibility necessary to assure continuous, reliable operation for all dry weather flows. No standby facilities are available, however, for operation at peak wet weather flows. Pump controls are automatic and operate in conjunction with suction sump water level. No attempt is made to recover some of the sewer "draw-down" head at higher flows.

The present pump suction layout has no provision for pump isolation. Flap gates are provided at the end of the discharge force main for each pump. No means is provided to isolate the flap gates for maintenance and repair.

Grit Removal and Disposal. The present grit removal tanks, which were designed to operate as aerated grit chambers, proved to be too small for this method of operation and are now operated as straight through flow units. Their capacity, however, is still inadequate for proper operation. Grit removed from the tanks is pumped to separator-dewatering units, which are of the cyclonic-screw type. The units do not function properly because the cyclonic separator is mounted with its apex above its vortex and the dewaterer is too small. As a result much of the material collected returns with the overflow from the units to the headworks.

Primary Sedimentation. The primary sedimentation tanks at the Southeast plant are presently being substantially revised. During the period of this study, the tanks in building 1 were being modified and it is understood that similar modifications will be undertaken on tanks in building 2 as soon as construction in building 1 is complete. Evaluation of the sedimentation tanks is made, therefore, on the tanks as modified. Modifications to the tanks include (1) replacement of diffuser plates in the preaeration tanks with spargers, (2) positive control of flow distribution to the tanks, (3) replacement of full-length longitudinal sludge collector with two shorter collectors, (4) installation of mechanical scum removal facilities, and (5) installation of submerged effluent collector pipes.

It is expected that all of these modifications will result in improvement in the operation of sedimentation tanks. Although submerged effluent collection will eliminate the carryover of floating material, the modified system does not eliminate the free fall of effluent into the collection troughs. This free fall is the source of odorous and potentially corrosive gases. Additionally, it is questionable whether the system will provide uniform collection over the entire area covered by the collection system. The air sprays provided as part of the scum collection system lack the ability to adequately skim the tanks.

While the modifications will improve the efficiency of the sedimentation tanks, satisfactory operation will not be attained until overflows from the sludge treatment and disposal system to the sewage treatment system are eliminated. As shown in Report 1, Phase I, these overflows consistently contribute about 60 percent of the solids load imposed on the sedimentation tanks and are the primary reason that effluent from the Southeast plant does not meet the requirements of the Regional Board.

Chlorination. Chlorination equipment at The Southeast plant is adequate although no standby is available during periods of peak demand. Because of the high dosages required for postchlorination, adequate mixing and dif-

fusion does not occur and at times chlorine escapes at its point of application.

Effluent Pumping. As presently designed, effluent pumping with a continuous mixture of bay water for dilution can only be achieved by drawing down the effluent sump to below tide level. Operation of the effluent pumping station is adequate with fully automatic controls, although it has never been tested under PWWF conditions. Pumps provide complete standby for each other under dry weather flow conditions. Station design, however, requires both pumps to be in operation during peak wet weather flow conditions.

Effluent Disposal. Under gravity flow conditions, dilutions obtainable through the existing submarine outfall are limited to about 40 to 1 for flows up to and including 70 mgd. With effluent pumping and predilution of the effluent with equal parts of sea water, higher dilutions should be obtained. At the present time, one of the effluent pipes crossing Islais Creek is ruptured and the effluent pumping station cannot be fully operated. As soon as this line is repaired, additional field work should be undertaken to determine the dilutions which can be obtained when the effluent is prediluted with sea water. Comtinuous operation of the effluent pumps will prevent any possible back up of tide into the outfall sewer.

Solids Treatment

The Southeast plant is provided with facilities to treat solids from both the Southeast and North Point plants. Solids contained in the liquid overflows from various sludge treatment facilities impose excessive loads on the sedimentation tanks at the Southeast plant and prevent them from producing an effluent of acceptable quality. To assure attainment of the best effluent possible from the Southeast plant requires that recycling of solids through the plant be stopped.

Sludge and Scum Removal. Modifications to the Southeast sedimentation tanks will eliminate the gravity sludge removal system. The modified tanks will each have two sludge removal pumps to provide positive withdrawal from the collection hoppers of the tanks. The pumps will operate under a high positive suction head and suction lines will be short. These modifications will improve substantially the removal of sludge. The discharge of the sludge into the scum troughs and then into mixing tanks appears to be unnecessary, however. Excellent thickening of sludge can be achieved in the sedimentation tanks and direct pumping of the sludge from the tanks to the digesters would simplify the operation and would also limit recycling of sludge by eliminating thickening tank overflows.

Sludge Thickening. The sludge thickening operation at the Southeast plant is perhaps the one that suffers most from the lack of preventive maintenance and good housekeeping. Thickening equipment and structures are seriously deteriorated and the odorous condition in the area discourages attempts on the part of the operators to perform anything but the most essential services. During this study, only one of the two thickeners was in an operable condition.

The efficiency of the thickening process is seriously affected by the combining of the Southeast sludge with the North Point sludge. The sludge age of this combination allows the thickeners to act as an open digester and gases formed within the digesting mass carry large masses of solids to the tank surface. Much of this solid material is carried with the overflow from the tanks to the sedimentation tanks influent. Excessive solids overflow is also aggravated by inadequate thickened sludge disposal. During the week of sampling at the Southeast plant, solids in the thickening tank overflow accounted for almost a third of the total solids load on the sedimentation tanks.

The thickened sludge transfer system is provided with instruments to measure sludge density and flow. These instruments were designed to control the transfer pumps so that only concentrated material is pumped to the digesters. Unfortunately, the equipment has not functioned properly and is now used only to determine elapsed time of pump operation. Equipment of this type can be made to function under proper conditions and is necessary to provide automatic control for the solids handling process.

If treatment efficiency is to be improved at the Southeast plant, the gross carryover of solids from the thickening process must be eliminated. Major revisions to or elimination of

the existing process should be undertaken. The modified system for sludge and scum removal from the Southeast sedimentation tanks will permit pumping these solids directly to the digesters. An efficient thickening and odor free system must be developed for solids from the North Point plant.

Sludge Digestion. Only five of the ten digesters at the Southeast plant are in operating condition. Of these, two are used under emergency conditions only and as a consequence are not actively digesting. Sludge from the thickening tanks is discharged daily to the remaining three digesters in sequence. No means are provided for mixing this sludge with circulated digesting sludge prior to discharge to the digester.

Loadings on the three operating digesters are high, averaging 0.30 lb solids per cu ft per day during the week sampling period reported in Report 1, Phase I. During this same week, volatile solids reduction in the tanks averaged only about 40 percent, considerably lower than should be obtained. If more digesters were modified and placed in operation so that loadings approached 0.10 lb solids per cu ft per day, substantially better digestion would be achieved resulting in higher reductions in volatile solids. This would reduce the solids load on the sludge conditioning and filtering systems. A comparison[4] of calculated velocity gradients within the digesters indicates that their mixing systems are functioning at about 1/2 to 3/4 of the rate required to maintain the digesters free of scum accumulation and grit deposition.

Sludge is withdrawn by gravity from the digesters to the elutriation tanks. No means for measuring the flow of digested sludge is provided and it is difficult to determine accurately digester performance. Some effort is made to estimate the quantity of digested sludge discharged based on the height of floating covers, but this method cannot be relied on for satisfactory data.

Control of digester loading and withdrawal is performed manually from the digester control center. This operation requires that this center be attended 24 hours a day, even though the operator in attendance also accomplishes other work in the area.

Sludge Conditioning and Disposal. Because of minimum digestion capacity and varying filter operation, the sludge elutriation tanks frequently operate as sludge storage facilities. During these times, the partially digested sludge continues digesting and gas formed buoys settled solids to the surface. Although some attempts are made to manually remove the floating material, most of it is hosed down to the effluent troughs and flows back to the sedimentation tanks influent.

Existing chemical and sludge filter feed controls are not sufficiently flexible or reliable to maintain efficient filtration of digested sludge. Large quantities of chemicals are required for this process and existing chemical storage facilities are insufficient to assure their continuous availability. Sludge filter feed pumps have limited capacities and practically no flexibility. The belt conveyor system which transports filter sludge cake from the filters to the storage bins has capacity for only one filter to operate at a time. Because of this, it is difficult to maintain a filtering rate equal to sludge production. Additionally, it is almost impossible to provide for filtering of sludge stored in the inactive digesters. Frequent malfunctions of the conveyor system force the complete shutdown of the operation of the filtering system. Present filter operation is, therefore, controlled by the condition of the elutriated digested sludge and the filter sludge cake transportation system and not by the quantity of sludge which is produced.

If sufficient liquid detention time were provided in the digestion system and the filtering system revised to permit handling of the sludge as it is produced, elimination of the elutriation system would be possible. Elimination of the overflow from this system to the sedimentation tanks would significantly improve the performance of the tanks and result in the production of a better effluent.

Supplemental Facilities

Revisions to the ventilation, power and control, and No. 3 water systems are required to bring the Southeast plant up to reasonable standards. Other supplemental facilities appear to be adequate.

Administration. Space in the administration building is adequate for personnel presently assigned to the plant. In addition to

plant personnel, offices for the Superintendent of the Water Pollution Control Division and for other City personnel are located in the Southeast administration building.

Maintenance. Although maintenance facilities are presently provided with sufficient space, storage space is at a minimum and must be enlarged to allow for expansion of maintenance activities. Special instrumentation maintenance facilities should be provided.

Ventilation. Although the Southeast plant is located in an industrial area of the City odor control is just as critical as at North Point and Richmond-Sunset plants. Proper ventilation and odor control should be provided to protect equipment and structures in the plant, to provide a reasonable environment for plant personnel, and to protect the surrounding developments. With the exception of the sludge thickening structure which has a powered supply and exhaust system, all structures are provided with a gravity supply and powered exhaust. To insure proper operation, all ventilation systems should be provided with powered supply and exhaust to maintain a slightly negative pressure in all areas where odors may be produced and a slightly positive pressure in all other areas.

If improvements are made to improve the sludge thickening process and eliminate the elutriation processes and to minimize as much as possible free fall of sewage, the areas in which odorous gases are emitted to the atmosphere will be substantially reduced. Other areas in which odors may be generated should be isolated and exhaust air from them scrubbed before discharge to the atmosphere.

Power and Control. Power distribution and motor control centers are scattered throughout the plant. While this in itself is not a problem, the difficulty of maintaining proper environmental conditions for the switchgear is. These centers should be isolated with the room provided with filtered air to maintain a dust free atmosphere. In areas with exposed sewage surfaces, equipment and apparatus should be of the sparkless type. The digester control buildings should be treated as hazardous areas.

Existing manual control requires that process equipment be operated from each individual control center. In most cases, this requires provision of around the clock attendance at these control centers to assure that all processes are properly controlled. If certain systems are automated and centralized control provided, operation manpower requirements during the evening and early morning shifts could be reallocated to maintenance. Lack of an adequate communication system also wastes manhours.

No standby power facilities are available to keep essential equipment in service or to assure orderly shut-down of critical processes during a power failure. Influent gate controls assure gate closure under such conditions.

Water Systems. The elevated water tank provides No. 1 and No. 2 water throughout the plant without pumping. After periods of excess filtered sludge production large amounts of City water are used to flush the plant drainage system. City water is presently metered and not billed. Its use is not a plant operating expense but is an expense to the City taxpayers.

The screening facilities on the No. 3 water system are badly deteriorated and in need of replacement. If the use of No. 3 water for skimming of the sedimentation tanks and for elutriation of digested sludge is discontinued, this system could be revised for use for chlorine injection. This would result in a reduction in the quantity of City water used for operation of the plant. The use of injectors near the point of application will assure that excessive chlorine is not used to meet the instantaneous demand of No. 3 injector water.

Steam Cleaning. Steam cleaning facilities use the high pressure steam generated in the plant boilers and there are no provisions for high pressure hot water cleaning. The existing high pressure steam boilers are 16 years old and each has operated about half the time. If these boilers were replaced with low pressure (10-15 psi) steam boilers, the need to provide continuous attendance in the boiler room would be eliminated. Separate steam cleaning facilities should then be provided.

Treatment Plant Personnel

Although the Southeast plant has the largest staff of any of the three plants, maintenance and upkeep of structures and equipment is the worst. The requirements imposed on the staff

to keep the processes in operation are such that little time is available for such tasks as routine maintenance or repair. In 1969-70 almost 10 percent of the total wages paid out at all three plants resulted from overtime premium time and other similar costs. In addition to the operation personnel listed in Report 1 of Phase I the Southeast plant is provided with two machinists, a full-time gardener and a full-time electrician.

No manpower seems to be available to perform preventive maintenance and repair. If the major improvements discussed above are undertaken, we believe that sufficient personnel would be released from the day-to-day operational requirements to perform these maintenance tasks.

CHAPTER 3

EVALUATION OF PRESENTLY PLANNED IMPROVEMENTS TO PLANT PROCESSES AND OPERATIONS

Presently planned improvements to plant processes and operations are intended to correct many of the problems discussed in Chapter 2. They do not, however, provide any correction for the overall problems associated with manual control of processes or with lack of adequate preventive maintenance and repair.

Included in the general improvement program are a number of studies and investigations applicable to all three or to two of the three water pollution control plants. These are (1) evaluation of location for disposal of effluent to the bay and ocean, (2) this study involving requirements for reduction of turbidity, grease, floatables and settleable solids, (3) evaluation of effectiveness of polymers in aiding solids settling in all three plants, and (4) study of odor problems and control.

The evaluation of the location for effluent disposal in the bay and ocean involves determining the feasibility of discharging treated effluent and wet weather overflows into deep water near Alcatraz and in the Gulf of the Farallones. As indicated in Report 2, Phase I, of this study, a properly designed deep-water outfall is required for both the North Point and Richmond-Sunset plants to obtain the high initial dilutions necessary to comply with requirements of the Regional Board.

This study, which relates to reductions necessary in turbidity, grease, floatables and settleable solids concentrations, is expected to provide the City with information regarding improvements and additions to treatment processes required to achieve the goals prescribed by the Regional Board for these variables.

The evaluation of the effectiveness of polymers entails a series of 30-day in-plant trials at each of the three plants to determine if any polymer improves the effectiveness of ferric chloride treatment in removing solids. The additional in-plant and pilot plant work being performed is important to determine if polymer addition in conjunction with low doses of ferric chloride significantly improves the efficiency of primary sedimentation.

The study of odor problems and control will involve a determination of ambient odor conditions and an analysis of requirements at each plant for compliance with the standards of the Air Pollution Control Board. Information obtained to date indicates that odor problems exist at all three plants at times.

NORTH POINT WATER POLLUTION CONTROL PLANT

The presently planned improvement program at the North Point plant includes the following items:

1. Provision of coagulant feed system.
2. Provision of sea water addition system.
3. Evaluation of polymer effectiveness.
4. Modification of solids removal system.
5. Construction of submarine outfall.
6. Evaluation of effluent pumping station.
7. Alteration of influent pumping system.
8. Modification of chlorination system.
9. Construction of facilities for reduction of turbidity and grease.
10. Construction of second sludge force main to Southeast plant.
11. Construction of interim floatable removal facilities.

Improvements suggested by the evaluation of present plant operations and processes in Chapter 2 not included in the above list are (1) modification of the influent gate control system, (2) revision of screenings and grit handling facilites, (3) revision of the influent pump discharge structure, (4) improvement of the maintenance facility, (5) revision of the ventilation system, (6) modification of the power and control system, and (7) improvement of the No. 2 water system.

Coagulant Feed System

Interim facilities for feeding ferric chloride have been in operation at the North Point

plant for about six months. Although some improvement in effluent quality has been achieved, full benefit will not be obtained until major modifications are completed to both the influent pumping system and the sedimentation tanks. Additional work is required to determine the most efficient and economical coagulant and the proper dosage rate for given requirements.

Sea Water Addition System

Addition of sea water with the coagulant apparently improves the efficiency of the solids separation process. It is planned to control addition of sea water by the conductivity of the plant influent. As with coagulant additions, the effectiveness of this process in increasing solids and turbidity removals will be continuously evaluted.

Evaluation of Polymers

Evaluation of the effectiveness of polymers in increasing solids and turbidity removals is continuing in conjunction with the coagulant feed system described above.

Solids Removal System

Present plans call for modification of the six sedimentation tanks to improve their operation and to reduce the carryover of macroscopic solids with the effluent. These modifications are intended to reduce the detention time of sludge in the tanks, to improve the scum skimming process, to increase floatable solids removal by submerging effluent withdrawal, and to improve the sludge withdrawal system. With these improvements, it is expected that effluent from the North Point plant will be improved and that present problems associated with excessive solids and floatables in the effluent will largely be alleviated.

Other improvements in the sedimentation tank area were suggested in Chapter 2. Although these additional improvements are not directly related to sedimentation tank efficiency, they do relate to the ability of the operator to maintain the tanks properly and thus to achieve maximum efficiency. We believe these additional improvements should be undertaken as soon as possible.

Submarine Outfall

Design of a submarine outfall for disposal of effluent from the North Point plant is presently underway. As previously noted, this outfall is required for compliance with the present requirements of the Regional Board. Design of the outfall is such that dilution in excess of 100 to 1 will be achieved for all flows up to 350 mgd. With this dilution and in conjunction with the other improvements discussed in this section, all present requirements of the Regional Board with regard to receiving water quality should be met.

Effluent Pumping Station

Preliminary estimates[6] indicate that all flows up to 150 mgd, the present maximum capacity of the North Point plant, can be discharged through the submarine outfall by gravity at all tidal elevations. If the capacity of the plant is increased, pumping of the effluent will be required. Final determination of the need and size of the effluent pumping station will be made after establishment of the wet weather flows which may be routed through the plant.

Influent Pumping System

Alterations to the influent pumping system include modification of the raw sewage pumps to provide variable speed pumping. These alterations should improve markedly the performance of the plant in that flow surges will be eliminated in the sedimentation tanks and, because of the decreased possibility of septic conditions developing in the pump sump, the tendency for sludge material rising to the surface of the sedimentation tanks will be reduced. In addition, reducing the size of the sump will minimize scum formation and solids deposition in the sump with their attendant maintenance and operational problems.

Chlorination System

Present plans call for improvements in the chlorination system to modernize and enlarge the existing system. As discussed in Chapter 2, improvements should include modifications of the chlorine diffusing systems and instal-

lation of a system with rapid response to flow changes. This system involves transport of chlorine gas under vacuum from chlorinators to injectors located at the point of application. Additionally, facilities should be provided for chlorination of the sludge to prevent decomposition in the sludge force main.

Turbidity and Grease Removal Facilities

Requirements for additional facilities required for reduction of turbidity and grease are discussed later in this report.

Sludge Force Main

As discussed in Chpater 2, disposal of solids from the North Point plant is dependent on the single sludge transfer force main to the Southeast plant. A second line is required, therefore, to assure satisfactory operation of the plant and continued compliance with the requirements of the Regional Board.

Interim Floatable Removal Facilities

Interim floatable removal facilities include wood baffles ahead of the sedimentation tank overflow launders with surface skimming facilities. If the skimmers are operated frequently enough to keep the surface upstream from the baffles free of accumulations of scum, this system will achieve some reduction in floatable material in the effluent. On the other hand, if the skimmers are not operated often enough, it is possible that a deterioration of the effluent could result. The automatic system provided should be satisfactory.

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

The presently planned improvement program at the Richmond-Sunset plant includes the following items:

1. Provision of coagulant feed system.
2. Provision of sea water addition system.
3. Evalution of polymer effectiveness.
4. Modification of solids removal system.
5. Modification of chlorination system.
6. Construction of submarine outfall.
7. Modification of digested sludge processing system.

Improvements suggested by the evaluation of present plant operations and processes in Chapter 2 not included in the above list are (1) modification of the influent and pretreatment structures, (2) revision of the grit disposal system, (3) modification of the administration building, (4) revision of the ventilation system, (5) revision of the power and control system, and (6) improvement of the No. 2 and No. 3 water systems.

Coagulant Feed System

A coagulant feed system is yet to be installed and the benefits therefrom evaluated at the Richmond-Sunset plant. Some improvement in effluent quality is expected when these interim facilities are placed in operation.

Sea Water Addition System

Plant scale tests are to be performed for evaluation of benefits obtained by addition of sea water in conjunction with coagulants. The effectiveness of this process in increasing solids and turbidity removals will be continuously evaluated.

Evaluation of Polymers

Evaluation of the effectiveness of polymers in increasing solids and turbidity removals is continuing.

Solids Removal System

Present plans call for modification of the five sedimentation tanks to reduce carryover of macroscopic material with the effluents. As discussed in Chapter 2, these modifications should include providing automatic operation for solids removal, replacement of the gravity system for solids withdrawal with direct pumping from each tank, abandoning of the concentration tanks, improvements of the scum skimming process, and providing submerged effluent collection. These modifications will materially improve effluent quality and will simplify operation of the system.

Other improvements which should be undertaken in the sedimentation tank area are revisions to the ventilation system and modification of the power and control facilities.

Chlorination System

Modifications of the chlorination system should include provision of prechlorination facilities and modernization of the existing system. Prechlorination will help in controlling odors in the plant and improving treatment efficiency. For best results, chlorination systems should be of the rapid response type involving transport of gas under vacuum from the chlorinators to the injectors located at the point of application.

Submarine Outfall

As noted in Chapter 2, present disposal of effluent from the Richmond-Sunset plant is not satisfactory and construction of a deep-water outfall is required. The location of the required outfall is presently under investigation, but preliminary studies indicate that dilutions in excess of 100 to 1 will be achieved. These dilutions in conjunction with other improvements discussed in this section should assure compliance with all present requirements of the Regional Board with regard to receiving water quality.

Digested Sludge Processing System

Improvements to the digested sludge processing system include those modifications necessary to permit elimination of the elutriation system. Elimination of this system will reduce the amount of solids recycled through the plant and will lead to production of a better effluent. The modifications should include providing floating covers on both digesters to permit independent feeding and withdrawal from the digester, revisions to the sludge piping system to increase operation and maintenance efficiency, and modernization and enlargement of chemical and sludge handling facilities to permit chemical conditioning of the sludge before filtration.

SOUTHEAST WATER POLLUTION CONTROL PLANT

The presently planned improvement program at the Southeast plant includes the following items:

1. Provision of coagulant feed system.
2. Provision of sea water addition system.
3. Evaluation of polymer effectiveness.
4. Repair of effluent outfall.
5. Evaluation of effluent outfall.
6. Modification of influent pumping system.
7. Modification of sludge filtering system.
8. Modification of solids removal system.
9. Modification of digesters 6 and 10.
10. Investigation of odor control.
11. Modification of chlorination system.
12. Modification of solids handling system.
13. Modification of grit removal system.

Improvements suggested by the evaluation of present plant operations and processes in Chapter 2 not included in the above list are (1) modification of the screenings removal system (2) revision of the influent pump discharge structure, (3) modification of the effluent pumping system, (4) activation of digesters 1 through 5, (5) modification of digester 7, (6) revision of the ventilation system, (7) modification of power and control system, and (8) improvement of No. 3 water and steam cleaning systems.

Coagulant Feed System

A coagulant feed system is yet to be installed and the benefits therefrom evaluated at the Southeast plant. It is doubtful that a significant improvement in effluent quality will result from operation of this system until improvements are made to eliminate recycling of solids through the primary tanks.

Sea Water Addition System

Plant scale tests are to be performed for evaluation of benefits obtained by addition of sea water in conjunction with coagulants. The effectiveness of this process in increasing solids and turbidity removals will be continuously evaluated.

Evaluation of Polymers

Evaluation of the effectiveness of polymers in increasing solids and turbidity removals is continuing.

Repair of Effluent Outfall

Repair of the effluent outfall involves

repair of pipe joints which failed at the Islais Creek channel crossing and reconstruction of at least three diffuser risers on the submarine outfall. This repair is required to permit operation of the effluent pumping station and to obtain the maximum dilution possible with the existing outfall.

Evaluation of Effluent Outfall

Evaluation of the effectiveness of the submarine outfall with and without effluent pumping was originally a part of this study. The evaluation without effluent pumping was completed as part of Phase I of this study. The evaluation with effluent pumping was not completed, however, because of the failure of the outfall at the Islais Creek crossing which prevents operation of the effluent pumping station. This evaluation should be completed as soon as the outfall is repaired so that dilutions obtainable with pumping will be known.

Influent Pumping System

Modifications to the influent pumping system includes construction of a pump room dewatering system and modernization of the main influent gates. Although these modifications will not have a direct effect on effluent quality, they will provide for better operation so that overall efficiency will be increased.

Sludge Filtering System

Modification of the sludge filtering system includes improvement of the sludge pumping system, modernization of the chemical feed system, and alteration of the sludge conveyor systems. These modifications are intended to achieve a balanced suldge filtering with adequate central control and to optimize the solids dewatering process. An improved sludge filtering system is required to permit abandoning of the elutriation system which is essential for improvement of sewage treatment efficiency at the Southeast plant.

Solids Removal System

Present plans call for the modification of the two sedimentation tanks in building 2 similar to the modification of the tanks in building 1. As discussed in Chapter 2, these modifications should result in improved effluent quality. Other improvements in the primary sedimentation area suggested in Chapter 2, including revisions to the ventilation and power and control systems, should be undertaken as soon as possible.

Digesters 6 and 10

Modification of digesters 6 and 10 will permit these digesters to be placed in operation. With these digesters in operation, organic loading on the digesters will be decreased and better digestion will be achieved. With better digestion, some of the problems associated with the digested solids processing system will be alleviated. The modifications generally include installation of gas-mixing equipment and revision of piping to provide multiple transfer points in each of the two digesters. Piping revisions should also provide for mixing of raw sludge with circulating sludge prior to discharge to the digester.

Odor Control

Investigation of odor control requirements are a part of the general study referred to earlier in the chapter.

Chlorination System

Modification of the chlorination system involves modernization of the existing system. These improvements should include modification of the effluent diffuser system and installation of a system with rapid response to flow changes. This system involves transport of chlorine gas under vacuum from chlorinators to injectors located at the point of application.

Solids Handling System

Improvement to the solids handling system is intended to reduce the quantity of solids recycled to the sedimentation tanks. As discussed in Chpater 2, this reduction is necessary to obtain maximum treatment efficiency. Some of the improvements to the system suggested in Chapter 2 are previously discussed but are repeated under this section to emphasize the

importance of eliminating to the maximum extent possible all recycling of solids materials. To assure this, improvements to the solids handling system should include (1) piping modifications to permit pumping solids directly from the sedimentation tanks to the digesters, (2) chlorination of North Point sludge prior to pumping it through the force main, (3) improvement of the thickening process for North Point sludge, (4) activation of all digesters to maintain low loading and to provide storage capability and operational flexibility, (5) elimination of the elutriation system, and (6) modification of the sludge filtering system.

Grit Removal System

Present plans call for construction of additional grit removal facilities to increase the capacity of the system. As discussed in Chapter 2, reconstruction of the pump discharge structure and grit removal tanks and complete revision of the grit separator-dewatering system should be undertaken to provide satisfactory operation of the system.

CHAPTER 4

PILOT PLANT AND LABORATORY STUDIES AT NORTH POINT

Studies of physical-chemical treatment processes that could be employed at the City's treatment plants were undertaken on a pilot plant scale to determine the relation of treatment cost to performance. For this purpose a 2.5 gpm pilot plant was constructed which provided for diurnal variation in flow (Fig. 4-1). Through the use of multiple compartments, it provides both for parallel operation of a test process and a control process, and for greater flexibility in process selection. Inital operations were conducted at the City's North Point Water Pollution Control Plant and the results of this work are reported herein. Features of the pilot plant are presented in the Pilot Plant Operating Manual.

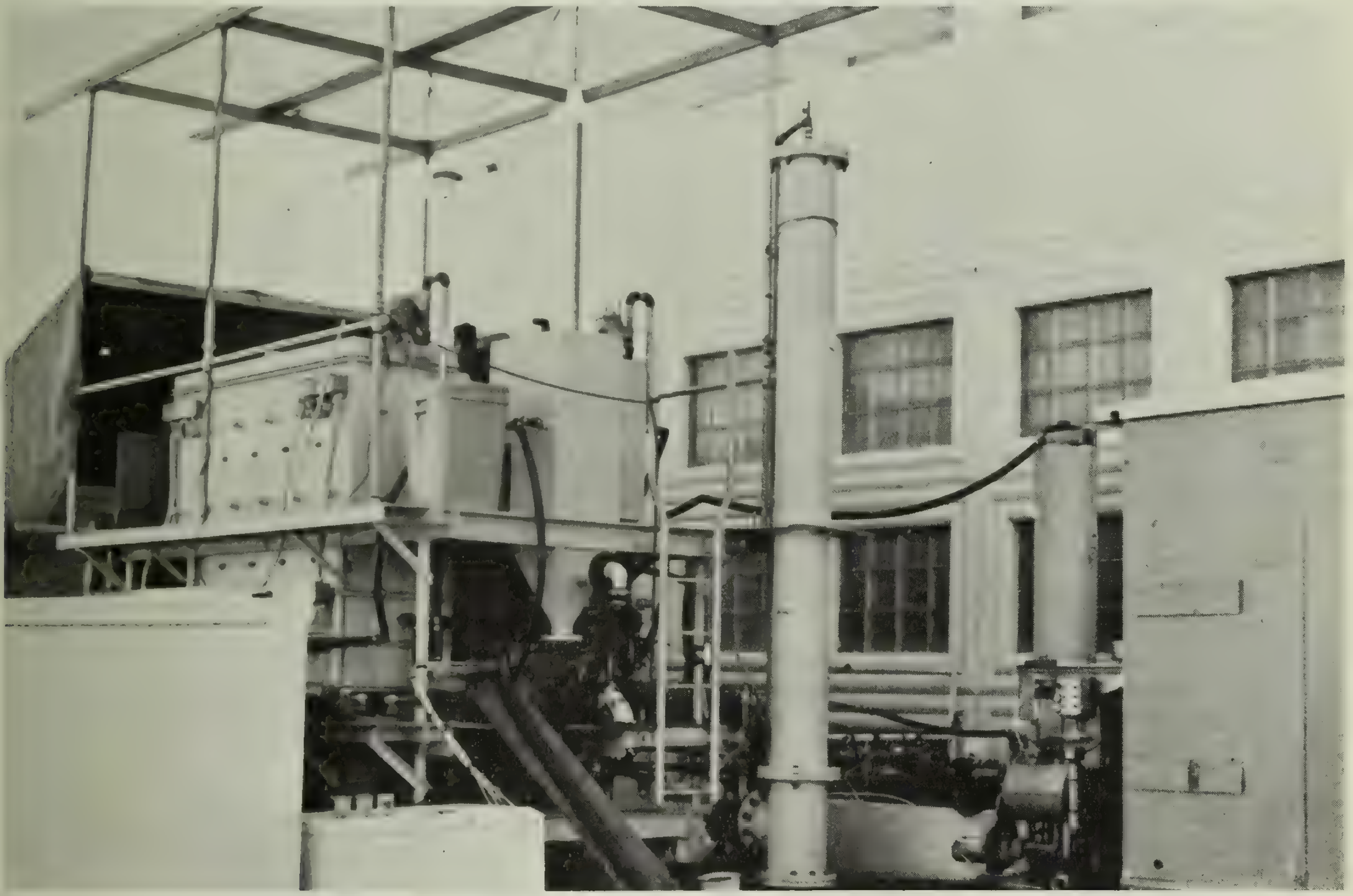


Figure 4-1

San Francisco's Advanced Waste Treatment Facility includes the multi compartment test unit (left), carbon column (center), multi-media rapid sand filter (right) and rental Komline-Sanderson pilot flotation unit (right)

OBJECTIVES AND SCOPE OF THE PILOT PLANT WORK

Potential future receiving water and effluent criteria have been established by the Regional Board and have been reviewed in Chapter 1 of this report. In the future, the City may have to meet receiving water criteria for grease, floatables, turbidity and discoloration in addition to the settleable solids, toxicity, dissolved oxygen, dissolved sulfides, pH, bacterial and aesthetic requirements. Reasonably adequate information is available about the expected performance of primary sedimentation and secondary biological treatment systems. However, available information concerning physical-chemical treatment systems is limited, especially since most investigators have not considered the full range of waste contaminants which are critical for planning waste treatment for the City of San Francisco. Most physical-chemical treatment performance data are in terms of the conventional parameters - BOD and suspended solids removals. Suspended solids is not directly expressed in the Regional Board's present and prospective requirements and BOD criteria are only applied under conditions when the receiving water dissolved oxygen (DO) falls below 5 mg/l. The BOD criteria will not be critical at the Richmond-Sunset and North Point plants when the new outfalls are put into operation. BOD may be a controlling parameter for the City's Southeast plant if the new Federal requirement for 85 percent BOD removal is imposed.

The experimental program at North Point was directed toward evaluating performance of physical-chemical treatment systems in terms of the waste water contaminants that will be of critical importance in meeting the receiving water criteria.

The system initially evaluated consisted of coagulation-flocculation-sedimentation in the following steps:

1. Chemical addition and coagulation of raw sewage by flash mix (lime and ferric iron were evaluated separately as coagulants.)
2. Flocculation by mild aeration.
3. Sedimentation.

If this scheme did not achieve the necessary performance, it was followed by the following ateps:

4. Multi-media filtration.
5. Carbon absorption (down flow column configuration).

Subsequent to the studies of coagulation-flocculation-sedimentation, a coagulation-flocculation-flotation sequence was evaluated. The sequence of operations was as follows:

1. Chemical coagulation and mixing by in-line chemical addition
ahead of the influent process pump.
2. Flocculation by paddle stirring in the modified rapid mix chamber.
3. Flotation in the rental pressure flotation pilot unit.

The rental flotation unit was used to treat both primary effluent and raw sewage with and without chemical addition. Lime and ferric chloride (from the plant's stock) were used separately as coagulants.

A total of 40 experimental runs were made at North Point during the two phases of work.

Concurrent with the field work, several additional studies were conducted in the laboratory for the purpose of analyzing possible additional unit processes, optimizing chemical doses, and computing underflow solids generation.

COAGULATION-FLOCCULATION-SEDIMENTATION

The treatment system comprising coagulation-flooculation-sedimentation is an attractive means for enhancing treatment plant performance because it entails maximum utilization of the existing plant and the minimum investment in new construction.

The pilot plant was set up for parallel operation of the test sequence of coagulation-flocculation-sedimentation and the control sequence of preaeration and sedimentation. The control sequence was operated to determine that the pilot plant would reasonably reproduce full scale primary sedimentation as well as to form a basis of comparison so that the effect of the coagulant used in the test sequence could be evaluated. The unit process operating criteria for this scheme of operation are indicated in Table 4-1. Flows were varied diurnally by a cam control system according to the curve shown in Fig. 4-2 which in turn was proportioned from the City's flow records for North Point on August 3, 1970.

Table 4-1

Operating Criteria for Coagulation - Flocculation - Sedimentation

	Lime flocculation Runs 1-7, 9		Ferric flocculation Runs 8, 10-13	
	ADWF[b]	PDWF[c]	ADWF[b]	PDWF[c]
Grit Removal				
Volume, gal	42	42	42	42
Surface area, sq ft	2.25	2.25	2.25	2.25
Surface loading,[a] gpd/sq ft	6,400	6,400	6,400	6,400
Detention time,[a] min	4.2	4.2	4.2	4.2
Preaeration (or Flocculation)				
Volume, gal	75	75	75	75
Surface area, sq ft	1.5	1.5	1.5	1.5
Detention time, min	30	30	30	30
Air flow rate, scfh				
Preaeration	20	20	20	20
Flocculation	10	10	10	10
G, rms velocity gradient, sec				
Preaeration	110	110	110	110
Flocculation	75	75	75	75
Recycle flow rate, gpm				
(Lime flocculation only)	0.9	1.2	-	-
Recycle duration, min/hr	20	20	-	-
Sedimentation				
Volume, gal	300	300	300	300
Surface area, sq ft	6	6	6	6
Detention time, hr	2	1.48	2	1.48
Surface loading, gpd/sq ft	600	820	600	820
Scum removal				
Flow rate, gpm	0.9	1.2	0.9	1.2
Duration, min	6	6	6	6
Sludge removal				
Flow rate, gpm	0.9	1.2	0.9	1.2
Duration, min.	4-8	4-8	8-16	8-16
Sand filtration				
Depth, sand, in.	-	-	6	6
Depth, anthracite, in.	-	-	18	18
Surface area, sq ft	-	-	1.08	1.08
Surface loading, gpm/sq ft	-	-	2.3	3.18
Carbon adsorption				
Volume (empty), gal	-	-	60	60
Surface area, sq ft	-	-	0.785	0.785
Detention time (empty), min	-	-	24	24
Surface loading, gpd/sq ft	-	-	3.2	4.3

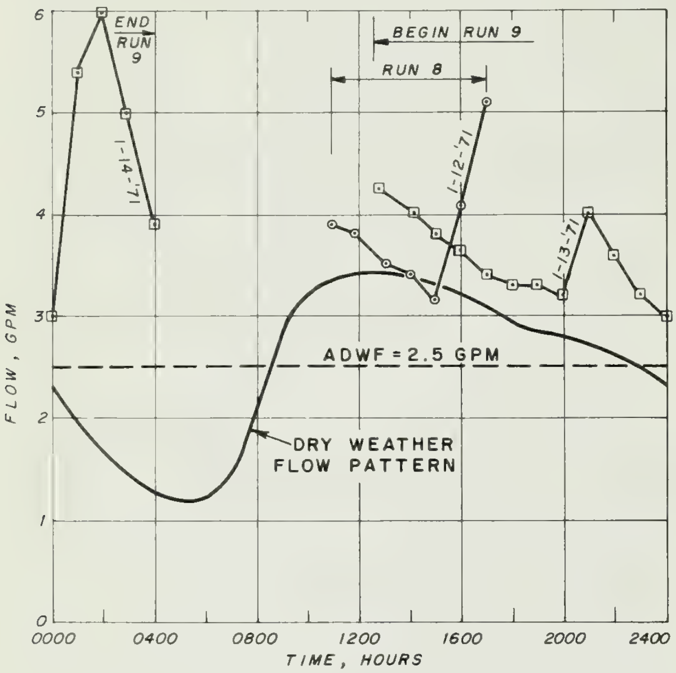
[a] At 10 gpm.

[b] ADWF = average dry weather flow = 2.5 gpm.

[c] PDWF = peak dry weather flow = 3.42 gpm.

Figure 4-2

Dry Weather Flow Pattern and Storm Flows of Runs 8 and 9.



Jar Test Results

Jar tests were run routinely for controlling coagulant dose purposes. A Phipps and Bird stirrer apparatus equipped with paddles one inch deep by three inches wide was employed in the testing. Stirring was at 30 rpm for 15 min and settling took place for 30 min in the stirred vessel (a 600 ml beaker filled to the 500 ml level). In all cases but the tests of December 9, 1970, the sample tested was a composite sample from the run indicated and was usually used for adjustment of dose in a subsequent run. With the exception of the first tests in each series, all lime utilized in the jar test was that used in the pilot facility (McKesson high calcium hydrated lime) and the ferric used in the jar tests and pilot facility was identical to that currently used at North Point.

Basic data obtained from the jar tests appear in Tables 4-2 and 4-3 and turbidity removals are plotted in Fig. 4-3 and 4-4. Data points for pilot plant runs, which will be discussed in a later section, are also indicated. As can be seen from the figures a higher turbidity

Table 4-2 Summary of Jar Tests - Lime

Lime alone

Date	Run	Comp	Grab	Turbidity and pH as a function of lime dose ($(Ca(OH)_2)$) mg/l											
				Control		50	100	138	175	200	250	300	350	400	500
12/9/70	-		X	JTU	43	31	21			4.5		1.2		1.0	
				pH	6.9	8.65	7.2			10.3		10.75		11.3	
12/29/70	1	X		JTU	43		18			2.1	2.2	1.7		1.0	
				pH	7.0		9.7			10.5	10.65	10.8		11.2	
12/30/70	2	X		JTU	60					4.1	3.0	2.3		1.8	1.0
				pH	7.2					10.5	10.9	10.9		11.45	11.65
1/5/71	4	X		JTU	50					10.0	5.7		2.0	1.0	1.1
				pH	7.05					10.5	10.65		10.8	10.85	11.05
1/6/71	5	X		JTU	59	43	31	26	16	13					
				pH	7.0	9.0	9.55	9.85	10.25	10.35					

Lime and activated carbon

Date	Run	Comp	Grab		Control no lime	Control lime alone	COD, turbidity and pH lime at 350 mg/l and activated carbon at stated conc			
							25	50	75	100
1/19/71	11	X		COD	379	186	183	183	175	179
				JTU	60	4.2	3.5	4.8	4.3	4.4
				pH	7.05	11.0	10.95	11.0	10.95	10.95

removal was always attained with lime than with ferric chloride. The scatter in the data is also somewhat less with lime, indicating that lime effectiveness as a coagulant may be less sensitive to changes in waste composition than a ferric salt.

The minimum turbidity with ferric chloride occurred at a dose of about 150 mg/l. Doses currently employed at North Point range from 15 to 50 mg/l. Two jar tests were conducted using Dow A-23 (Table 4-3), an anionic polymer, with ferric chloride. Dow A-23 has been used successfully with ferric salt at the Valley Community Services District plant and at other locations in this country. From these jar tests, it was inferred that a dose of 100 mg/l of ferric chloride and 0.9 mg/l A-23 should produce an effluent turbidity equivalent to that obtained at 150 mg/l ferric dose.

One additional jar test was used to evaluate the potential of adding activated carbon during the addition of lime for soluble COD (or BOD) reduction. These results are reported in Table 4-2. As shown, little benefit was gained from the addition of activated carbon under these conditions. Under high pH conditions carbon is less effective in absorption in terms of rates and equilibria than in the neutral pH range.

Table 4-3

Summary of Jar Tests - Ferric Chloride

Ferric alone

Date	Run	Comp	Grab	Turbidity and pH vs. ferric dose as $FeCl_3$, mg/l										Chloride mg/l
				Control		25	50	75	100	150	200	300	400	
12/9/70			X	JTU	42		18		5.7		33	54	39	440[1]
				pH	6.9		6.5		5.6		3.45	3.0	3.0	
12/9/70			X	JTU	46	31	16	10	3.8	5.0				440[1]
				pH	7.0	6.8	6.4	5.9	5.4	3.85				
1/7/71	6	X		JTU	5.5	34	22	12	6.6	4.7				1140
				pH	7.0	7.0	6.65	6.35	6.05	5.05				
1/8/71	7	X		JTU	51		23	12	5.4	3.7	9.7			1000
				pH	6.9		6.8	6.4	6.1	5.0	3.65			
1/13/71	8	X		JTU	49		29	20	23	9.5	2.0			440
				pH	7.1		6.95	6.5	6.5	6.35	5.2			
1/14/71	9	X		JTU	45		28		8.9	2.0	13			280
				pH	7.15		6.75		6.20	5.2	3.6			
1/20/71	10	X		JTU	33	23	17	12	3.2	1.9				1080
				pH	7.1	7.1	6.8	6.6	6.3	5.7				

Ferric and Dow A-23

Date	Run	Comp	Grab	Ferric Dose mg/l	Control		Polymer dose Dow A-25					Chloride mg/l
						0	0.1	0.3	0.5	0.7	0.9	
1/15/71	10	X		100	JTU	37	7.4	6.5	6.2	3.4	1.8	411
				Control	pH	7.1	6.4	6.3	6.25	6.3	6.35	
1/15/71	10	X		150	JTU	35	2.1	1.7	2.0	2.0	2.3	411
				Control	pH	7.05	5.7	5.3	5.4	5.4	5.4	

[1]From plant personnel

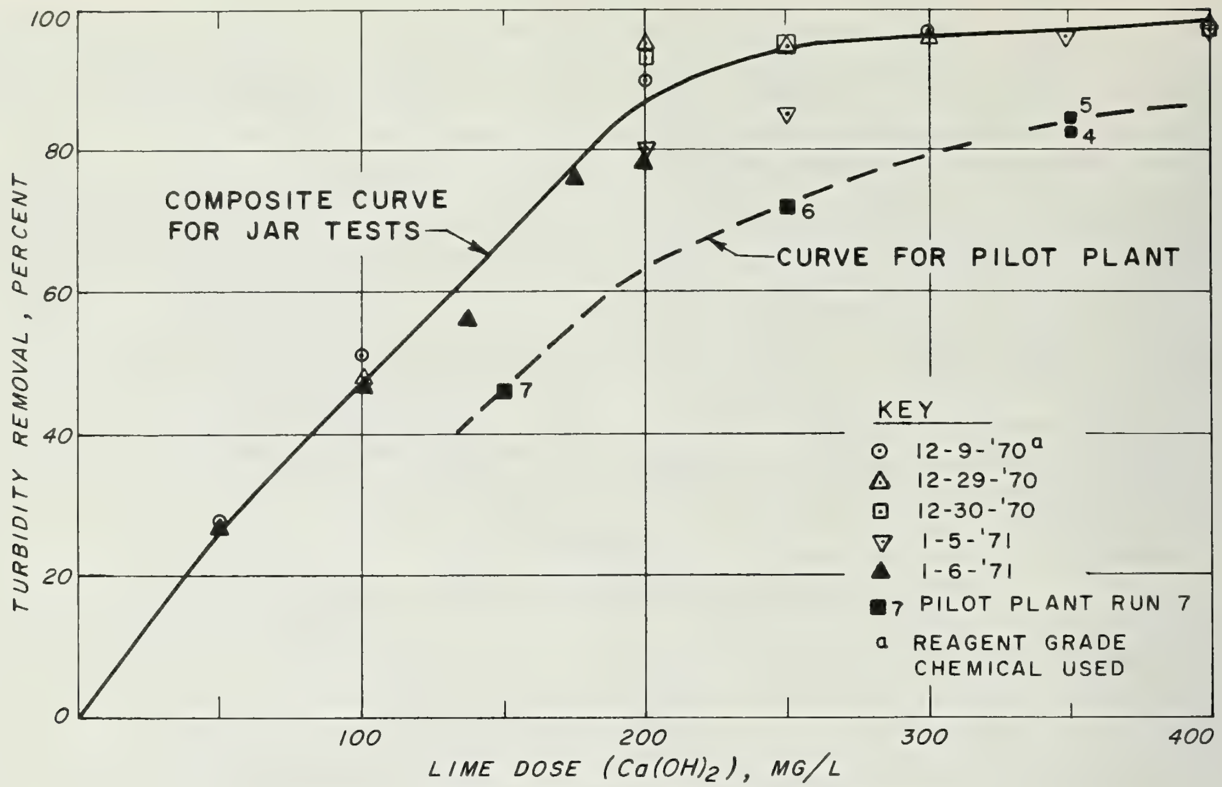


Figure 4-3. Turbidity Removal with Lime in Jar Test

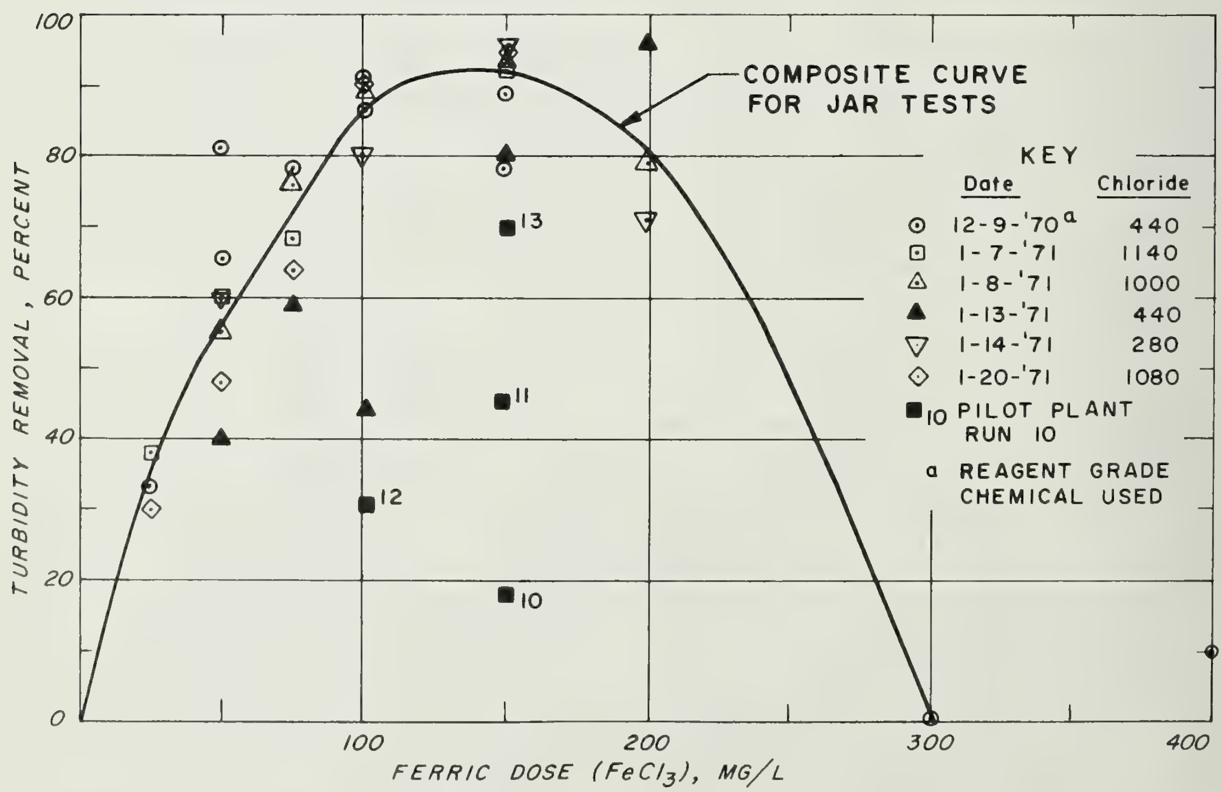


Figure 4-4. Turbidity Removal with Ferric in Jar Test

Alum was employed in only one jar test and was not employed in the pilot plant. Alum was not used as a coagulant because it proved less effective than either lime or ferric chloride in pilot plant raw sewage flocculation studies conducted at the University of California.[8]

Process Performance-Composite Data

Samples of process influents and effluents were continuously collected. The samples were composited proportional to flow by Sigma pumps and stored in refrigerated compartments. Daily composites were analyzed routinely by Brown and Caldwell Laboratories for:

1. Turbidity (Hach Model 2100, Serial No. 1227).
2. Alkalinity.
3. pH.
4. Settleable solids (volume basis)
5. Suspended solids.
6. Grease (hexane extractables)
7. COD
8. Chloride (influents only)

Less frequently, composite samples were subject to the following additional analysis:

1. Toxicity (effluents only; analysis by Pacific Environmental Laboratory, San Francisco, California).
2. BOD
3. MBAS
4. Color
5. Floatables

Routine Analyses. Data and removal efficiencies of the waste water constituents which were analyzed routinely are presented in Table 4-4 for the runs with lime and Table 4-5 for the runs with ferric chloride.

Difficulties with lime feedings were experienced during runs 1-3. Lime was initially delivered by a Sigma pump through 5/16 tygon tubing. During the low flow period at night, the tubing would clog due to settling of lime solids in the vertical section of the tubing. This problem was alleviated after run 2 by replacing the 5/16 in. tubing with two 3/16 in. feed tubes. Lime feeding was mistakenly interrupted during the night portion of run 3 by a City treatment plant operator. As a consequence, the dose rates indicated for runs 1-3 are nominal values only. The composite effluent quality deteriorated due to interruption of chemical feed.

As indicated by the results with lime for runs 4 to 7 (Table 4-4), removals of waste water constituents with lime were closely associated with the dose, as would be expected from the jar tests. High removals were obtained at a dose of 350 mg/l (runs 4 and 5) during which the concentration of each constituent was within the limits of the most severe criteria of the Regional Board. At this dose, an effluent with a grease level of less than 5 mg/l, turbidity less than 10 JTU, and settleable solids less than 0.1 ml/l/hr can be attained without subsequent effluent polishing.

The turbidity removals with lime have also been expressed on a common basis as the jar test results in Fig. 4-3. The percentage removals are expressed relative to the primary treatment control. As can be seen in the figure, the removals attained in the pilot plant did not equal those obtained in the jar test. However, the pattern of improvement in removals with increased dose was similar. The difference between results obtained in the jar test and those obtained in the pilot plant may be due to any of the following factors acting singly or in combination:

1. Post precipitation of $CaCO_3$ may occur in sample collection and cloud the sample.
2. Settling conditions in the jar test are quiescent, whereas sedimentation in the pilot facility is subject to some turbulence induced by entry and exit conditions, density currents, and the horizontal flow velocity.
3. Energy dissipation in the jar test during flocculation is more uniform than energy dissipation in the aerated flocculator for the same "G" level which would cause greater floc breakup in the pilot facility than in the jar test.
4. Flocculation in the jar test is under batch or simulated "plug flow" conditions, whereas flocculation in the pilot facility is under the less efficient "completely mixed" conditions.

Significantly, effective grease removal was attained over a wide range of lime doses. If grease or floatable removal becomes the critical criteria, lower lime doses might be employed. At the lower lime doses, more effluent settleable solids can be expected.

Table 4-4

Flocculation - Sedimentation Performance with Lime

Run number Date Lime dose, mg/l as $Ca(OH)_2$	1[a] December 28-29, 1970 300		2[a] December 29-30, 1970 350		3[a] December 30-31, 1970 350	
	Concentration	Removal, percent	Concentration,	Removal, percent	Concentration	Removal, percent
Turbidity (JTU)						
Influent	73		81		57	
Primary effluent (control)	43	41	58	35	48	16
Floc-sed effluent	18	76	17	79	18	68
Grease, mg/l						
Influent	55		52			
Primary effluent (control)	32	42	27	48		
Floc-sed effluent	14	75	6	88.5	6	
Total suspended solids, mg/l						
Influent	140		150		120	
Primary effluent (control)	76	46	71	53	40	67
Floc-sed effluent	32	77	40	73	56	53
COD, mg/l						
Influent	443		413		420	
Primary effluent (control)	279	37	299	27.5	313	25.5
Floc-sed effluent	186	58	193	53.4	171	59
Settleable solids, ml/l/hr						
Influent	5.0		2.5		3.0	
Primary effluent (control)	0.7	86	1.2	52	0.07	97
Floc-sed effluent	0.05	99	0.05	97	1.1	63
pH						
Primary effluent (control)	7.0		7.1		7.3	
Floc-sed effluent	10.7		10.3		11.5	
Alkalinity, mg/l as $CaCO_3$						
Primary effluent (control)	117		93		126	
Floc-sed effluent	335		178		226	
Chlorides, mg/l						
Influent						

Run number Date Lime dose, mg/l as $Ca(OH)_2$	4 January 4-5, 1971 350		5 January 5-6, 1971 350		6 January 6-7, 1971 350		7 January 7-8, 1971 250	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity (JTU)								
Influent	61		68		78		52	
Primary effluent (control)	44	28	47	31	58	26	39	25
Floc-sed effluent	7.5	88	7	90	32	59	11	79
Grease, mg/l								
Influent	33		60		31		61	
Primary effluent (control)	22	33	42	30	23	26	40	34.5
Floc-sed effluent	4	88	1	98	7	77.5	4	93.5
Total suspended solids, mg/l								
Influent	110		110		190		166	
Primary effluent (control)	54	51	76	31	106	44	89	46
Floc-sed effluent	23	79	7	96	101	47	38	77
COD, mg/l								
Influent	418		445		470		472	
Primary effluent (control)	269	36	281	37	328	30	277	41
Floc-sed effluent	169	60	173	61	253	46	217	54
Settleable solids, ml/l/hr								
Influent	2.5		3.0		4.0		3.0	
Primary effluent (control)	<0.1	>99	0.3	90	0.7	83	0.6	80
Floc-sed effluent	<0.1	>99	<0.1	>99	0.3	92.5	0.4	87
pH								
Primary effluent (control)	7.6		7.3		7.0		7.1	
Floc-sed effluent	10.6		10.3		9.9		10.9	
Alkalinity, mg/l as $CaCO_3$								
Primary effluent (control)	125		120		144		138	
Floc-sed effluent	334		286		222		160	
Chlorides, mg/l								
Influent	1280		1160		1140		1000	

[a]Nighttime problem with lime feed.

Table 4-5

Flocculation - Sedimentation Performance with Ferric Chloride

Run number Date Ferric dose, mg/l as $FeCl_3$	10 January 14-15, 1971 150			11 January 18 - 19, 1971 150		
	Concentration	Overall removal, percent	Unit removal, percent	Concentration	Overall removal, percent	Unit removal, percent
Turbidity (JTU)						
Influent	48			57		
Primary effluent (control)	33	31	31	42	26	26
Floc-sed effluent	27	44	44	23	60	60
Sand filter effluent	2.7	91	90	8	86	65
Carbon column effluent	0.85[a]	98[a]	70[a]	3	95	63
Grease, mg/l						
Influent	43			35		
Primary effluent (control)	24	44	44	22	37	37
Floc-sed effluent	7	84	84	3	92	92
Sand filter effluent	5	88	29	1	97	67
Carbon column effluent	2	95[a]	60[a]	3	92	-200
Total suspended solids, mg/l						
Influent	97			120		
Primary effluent (control)	78	20	20	67	44	44
Floc-sed effluent	49	50	50	38	68	68
Sand filter effluent	5	94	90	15	79	61
Carbon column effluent	2[a]	98[a]	60[a]	16	78	58
COD, mg/l						
Influent	356			386		
Primary effluent (control)	214	40	40	281	28	28
Floc-sed effluent	176	51	78	183	53	53
Sand filter effluent	130	64	26	158	59	14
Carbon column effluent	23[a]	95[a]	82[a]	58	85	63
Settleable solids, ml/l/hr						
Influent	1.5			2.5		
Primary effluent (control)	0.05	97	-	$<$ 0.1	$>$ 96	-
Floc sed effluent	0.05	97	-	$<$ 0.1	$>$ 96	-
Sand filter effluent	$<$ 0.1	93	-	$<$ 0.1	$>$ 96	-
Carbon column effluent	0.05[a]	97[a]	-	$<$ 0.1[a]	$>$ 96[a]	-
pH						
Primary effluent (control)	7.4	-	-	7.2	-	-
Floc-sed effluent	6.7	-	-	6.9	-	-
Alkalinity, mg/l as $CaCO_3$						
Influent	136			116		
Floc-sed effluent	33			26		
Chlorides, mg/l						
Influent	411			617		

[a]Grab sample at 1100 hours.

Table 4-5 (Continued)

Flocculation - Sedimentation Performance with Ferric Chloride

Run number Date Ferric dose, mg/l as $FeCl_3$	12 January 19 - 20, 1971 100			13 January 20 - 21, 1971 150		
	Concentration	Overall removal, percent	Unit removal, percent	Concentration	Overall removal, percent	Unit removal, percent
Turbidity (JTU)						
Influent	60			54		
Primary effluent (control)	39	35	35	46	15	15
Floc-sed effluent	27	52	52	14	71	71
Sand filter effluent	10	83	66	4.9	91	64
Carbon column effluent	3.1[a]	95[a]	70[a]	1.5[a]	9.7[a]	69[a]
Grease, mg/l						
Influent	35			36		
Primary effluent (control)	23	37	37	25	31	31
Floc-sed effluent	7	80	80	4	89	89
Sand filter effluent	5	86	28	5	86	-25
Carbon column effluent	4[a]	89[a]	20[a]	3[a]	92[a]	40[a]
Total suspended solids, mg/l						
Influent	120			136		
Primary effluent (control)	88	27	27	96	29.4	29.4
Floc-sed effluent	52	57	57	29	79	79
Sand filter effluent	21	82	60	10	93	66
Carbon column effluent	10[a]	92[a]	52[a]	6[a]	96[a]	40[a]
COD, mg/l						
Influent	363			367		
Primary effluent (control)	239	34	34	295	20	20
Floc-sed effluent	168	54	54	147	60	60
Sand filter effluent	141	61	16	115	69	22
Carbon column effluent	68[a]	81[a]	52[a]	69[a]	81[a]	40[a]
Settleable solids, ml/l/hr						
Influent	2.5			2.5		
Primary effluent (control)	$<$ 0.1	$>$ 96	-	0.25	90	-
Floc-sed effluent	$<$ 0.1	$>$ 96	-	$<$ 0.1	$>$ 96	-
Sand filter effluent	$<$ 0.1	$>$ 96	-	$<$ 0.1	$>$ 96	-
Carbon column effluent	$<$ 0.1	$>$ 96	-	$<$ 0.1	$>$ 96	
pH						
Primary effluent (control)	7.2	-	-	7.0	-	-
Floc-sed effluent	6.9	-	-	6.4	-	-
Alkalinity, mg/l as $CaCO_3$						
Influent	148			141		
Floc-sed effluent	57			44		
Chlorides, mg/l						
Influent	1080			1670		

[a]Grab sample at 1100 hours.

Experimental results for the runs employing ferric chloride as the primary coagulant are recorded in Table 4-5. As can be seen from the data, the improvement with ferric addition at the "optimum" dose from the jar tests did not yield the dramatic improvements expected from the jar tests in effluent quality unless sand filtration was added to the treatment sequence. A significant exception to this was the high grease removals attained in all runs.

The jar tests had indicated that Dow A-23 might be profitably added to reduce the required ferric chloride dose. Approximately equivalent effluent quality was obtained with 100 mg/l ferric chloride and 0.9 mg/l Dow A-23 compared to 150 mg/l ferric chloride alone. Increased bay water pumping during run 12 may have clouded the picture, however.

During run 13, the City was pumping bay water into the treatment plant influent to enhance the improvement attained with ferric chloride addition in the main plant. This may have improved pilot plant effluent quality, as removals of the various constituents were greater during run 13 than during either run 10 or 11 when no additional bay water was pumped in with the influent.

The turbidity removals were plotted with the jar test results as was done with the lime test series. All but run 13 data fell far below the jar test results. The reasons for this difference are very likely those suggested for the lime test series, with the exception of post precipitation in the sample. Samples withdrawn in beakers from the flocculator and allowed to settle for one-half hour indicated by visual inspection that the suspension was more dispersed in the flocculator than under jar test conditions. The ferric floc appears to be fairly fragile and susceptible to breakup under the conditions of turbulence in the aerated flocculator as compared with the mild turbulence in the jar test.

Color Removal. Specific criteria for allowable receiving water color discoloration have not been established or suggested by the Regional Board to date. This is partly a result of the absence of quantative criteria for apparent color or allowable color deviation from adjacent waters. During this work and the oceanographic studies, the color absorption spectrum of the sample has been utilized for quantitative measurements. To restrict the measurement to colloidal or soluble color and remove the interference ot particulate matter, the samples were filtered through a 0.45 μ Millipore filter for size classification prior to color measurement. A Beckman DU with 5 cm cell was employed in all measurements with distilled water as a reference liquid.

Both ferric chloride and lime were effective in substantially reducing color in wastewater (Fig. 4-5 and 4-6). The addition of the carbon column in the treatment sequence yielded further reductions in color. It is notable that both the ferric clarified effluent and lime clarified effluent contained less color than the bay water sample collected on November 10, 1970, (Report 2, Phase I, Fig. 2-1), except at the extremes of the visible spectrum adjacent to 400 and 800 mμ.

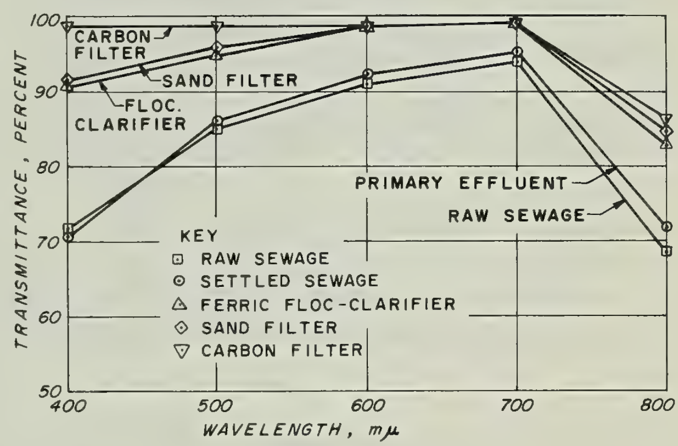


Figure 4-5

True Color of Influents and Effluents with Ferric Flocculation - Sedimentation (Run 11)

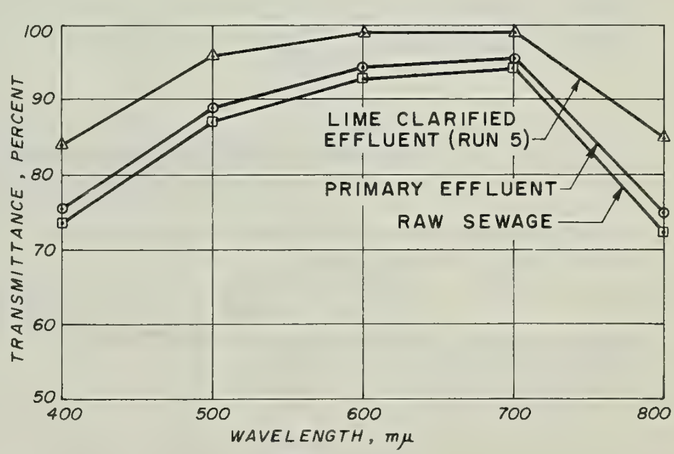


Figure 4-6

True Color of Influents and Effluents with Lime Clarification (Run 5)

It has been suggested that the absorbance spectrum may be too cumbersome a criterion for practical assessment of treatment plant performance and environmental measurement. Color chromaticity analysis[9] had been suggested as a possible means for reducing the entire color absorbance spectrum to several parameters as follows:

1. Dominant wave length
2. Purity
3. Hue (or color designation)
4. Luminance, percent

To apply the technique, the transmittance values had to be interpolated from the curve at standard wave lengths. Trichromatic coefficients and tristimulus values were then computed[9]. From these coefficients, the four parameters were determined for the samples from runs 5 and 11 and are reported in Tables 4-6 and 4-7. The only parameter of significance is the luminance of the sample, since the "purity" of the samples was very low. In other words, the samples cannot be described as having a dominant wave length or hue. Luminance is an average percent transmittance for the absorption spectrum and seems to be the only useful parameter describing the spectrum which derives from chromaticity analysis.

For comparison purposes the color absorption spectrum of the November 10, 1970 bay water sample has been analyzed by the same procedure. Significantly, the sedimentation effluent using lime or ferric contained less color than the bay water sample as indicated by the luminance parameter. (Table 4-8).

Table 4-8.
Summary of Color Chromaticity Analysis for Bay Water Collected at Outfall Site on November 10, 1970

Dominant Wavelength, $m\mu$	a
Purity, percent	a
Hue	a
Luminance, percent	96

[a]Located at center of chromaticity diagram.

Table 4-6

Summary of Color Chromaticity Analysis during Lime Clarification

	Source		
	Raw sewage	Primary effluent control	Lime clarified effluent
Dominant wavelength, $m\mu$	580	580	570
Purity, percent	6±	6±	4±
Hue	yellow	yellow	green-yellow
Luminance, percent	90	92	97

Table 4-7

Summary of Color Chromaticity Analysis of Influent and Effluents during Ferric Flocculation and Sedimentation (Run 11)

	Source				
	Raw sewage	Primary effluent (control)	Ferric floc-clarifier	Sand filter	Carbon filter
Dominant wavelength,	580	580	580	580	450
Purity, percent	7	7	2	2	2
Hue	yellow	yellow	yellow-orange	yellow	violet
Luminance, percent	88	89	97	97	98.7

Toxicity Removal. Hourly 15 gallon composite samples of the effluents from the test and control schemes were manually collected proportional to flow for run 5, lime treatment, and run 11, with ferric chloride. To eliminate the toxic effect of low or high pH, which would not accur after dilution of the effluent through an outfall acid was added to the test sample from run 5 to reduce the pH to 8.5. In run 11 the test effluents were raised to pH 7 by adding base. Sticklebacks were the test organism.

Substantial reductions in effluent toxicity were obtained by the test scheme over the control scheme (Table 4-9). During run 11 additional polishing by sand filtration and carbon absorption did not seem to enhance significantly toxicity removal. The fact that carbon absorption and the resulting increased removal of constituents after coagulation of organics did not reduce effluent toxicity suggests that the remaining toxic constituents after flocculation and sedimentation were not carbonaceous matter. The complete survival of test organisms in run 5 after coagulation, flocculation and sedimentation alone would seem to confirm this hypothesis, i.e., relatively complete removal of carbonaceous matter was not required to insure complete organism survival in the flocculation-sedimentation effluent of run 5. The removal of metals have been found effective at high pH and the high toxicity removals may be due to the removal of metals. It should be noted that none of the effluents were chlorinated prior to sampling and toxicity assay in the pilot studies.

BOD Removal. BOD removal efficiencies are compared to COD removals for runs 5 and 11 in Table 4-9. It can be seen that approximately 60 percent COD removal and 70 percent BOD removal can be attained with efficient solids separation. Additional COD and BOD removal can be obtained with activated carbon adsorption of soluble and colloidal organics.

MBAS. The Methylene blue period was applied for influent and effluent analysis of surface active materials (Table 4-9). While some removals were obtained in both the test and control treatment sequences, carbon adsorption was required for high removal of surfactants.

Floatables. Effluent from the test sequence with lime contained significantly less floatables than effluent from the control sequence. When ferric chloride was used, however, a comparable reduction was not obtained.

Table 4-9

Special Analyses for Coagulation - Flocculation - Sedimentation (Runs 5 and 11)

Effluent and run description	Survival in undiluted effluent after 96 hr, percent	Median tolerance limit(TLm), percent	BOD		COD		MBAS		Floatables, mg/l
			mg/l	Removal, percent	mg/l	Removal, percent	mg/l	Removal, percent	
Run 5 - Lime									
Influent			217		445	1	3.6		
Primary sedimentation (control)	40	91	131	40	281	31	3.4	6	2
Floc-sed effluent	100	>100	61	72	173	61	2.7	25	0.1
Run 11 - Ferric									
Influent			150		386		4		
Primary sedimentation (control)	20	32	120	20		28	2.1	47	0.8
Floc-sed effluent	70	>100	70	53	183	53	2.0	50	0.6
Sand filter effluent	80	>100	50	67	158	59	2.8	30	
Carbon column effluent	70	>100	6	97	58	85	0.08	98	

Comparison of Pilot Facility to Full Scale Plant Performance

A comparison of full scale plant performance to pilot performance is presented in Table 4-10. An appropriate period for plant scale comparison is July 30, 1970 to August 5, 1970 since ferric chloride was not added to the plant influent during that period. The results for the control sequence in runs 1-7 were averaged for comparison purposes. As can be seen from the data, there was excellent agreement between pilot plant and field scale results under comparable operating conditions.

Process Performance During Peak Flows

Grab samples were taken during the peak flow period (11:00 A. M.) and analyzed for certain constituents. Results are indicated in Tables 4-11 and 4-12. Percentage removals indicated reflect transient conditions and therefore should be used with caution. In general, performance did not excessively deteriorate during peak dry weather flow period.

Wet weather during the week of January 11 to 15, 1971, allowed several storms to be run through the pilot facility to determine the stability of the test sequence to hydraulic overload. The storm flows, extrapolated to pilot scale and run through the pilot plant are indicated in Fig. 4-2.

Table 4-10

Comparison of Pilot Scale to Plant Scale Results

Parameter	Pilot scale runs 1 - 7		Plant scale 7/30 to 8/5/70	
	Concentration	Removal percent	Concentration	Removal percent
Grease, mg/l				
Influent	49		54	
Primary effluent	28	43	38	30(27)
TSS, mg/l				
Influent	140		194	
Primary effluent	73	48	90	53(54)
COD, mg/l				
Influent	440		493	
Primary effluent	293	33	338	30(33)
Settleable solids, ml/l/hr				
Influent	3.3		6.0	97
Primary effluent	0.4	88	0.2	

( ) = mass balance basis

Table 4-11

Grab Tests with Coagulation - Flocculation - Sedimentation with Lime at Peak Flow

Run no	Date	Lime dose as $Ca(OH)_2$ mg/l	Turbidity JTU Influent	Turbidity JTU Primary	Turbidity JTU Test	Turbidity Per cent removal Primary	Turbidity Per cent removal Test
3	Dec 30-31	350	68	38	19	44	72
4	Jan 4-5	350	92	47	18	49	80
5	Jan 5-6	350	83	48	15	42	82
6	Jan 6-7	175	68	56	32	18	53
7	Jan 7-8	250	90	53	10	41	89

Run no	Date	Lime dose as $Ca(OH)_2$ mg/l	T. Suspended Solids mg/l Influent	T. Suspended Solids mg/l Primary	T. Suspended Solids mg/l Test	T. Suspended Solids Per cent removal Primary	T. Suspended Solids Per cent removal Test	pH Influent	pH Primary	pH Test
3	Dec 30-31	350						7.2	7.4	10.8
4	Jan 4-5	350						7.15	7.5	10.8
5	Jan 5-6	350	267	101	40	62	85	7.05	7.5	10.2
6	Jan 6-7	175	450		33		92	7.4	7.3	10.1
7	Jan 7-8	250						6.35	6.9	10.2

Table 4-12

Grab Tests with Coagulation - Flocculation - Sedimentation with Ferric Chloride at Peak Flow

Run No.	Jan. 1971	Ferric dose as $FeCl_3$, mg/l	Units	Turbidity JTU or percent removal Inf	Pri	Floc-clar	Sand filter	Carbon filter	Total suspended solids Mg/l or percent removal Inf	Pri	Floc-clar	Sand filter	Carbon filter
10	14-15	150	Concentration	48	29	24	1.7			72	46	7	
		Cl^- 411	Overall removal		40	50	96						
			Unit removal		40	50	93						
11	18-19	150	Concentration	83	37	40	1.9	0.7	294	72	51	4	1.2
		Cl^- 617	Overall removal		55	52	98	99		75	83	99	99
			Unit removal		55	42	95	63		75	83	92	70
12	19-20	100	Concentration	58	48	18	3.7	3.1	200	140	54	12	8
		0.9 mg/l A-23	Overall removal		17	69	93	95		30	73	94	96
		Cl^- 1080	Unit removal		17	69	79	16		30	73	78	33
13	20-21	150	Concentration	77	44	26	6.8	1.5	228	97	62	4	6
		Cl^- 1670	Overall removal		43	66	91	97.5		57	73	98	97
			Unit removal		43	66	74	78		57	73	94	-50

During run 8, with ferric chloride added at 100 mg/l, effluent quality during the storm deteriorated markedly from what would be expected during dry weather from the results of the other runs. High effluent turbidity, suspended solids and settleable solids characterized the effluent during the storm (Table 4-13).

Run 9 had two distinct periods: (1) a "dry weather" period (run 9) from 1400 to 2000 and a "wet weather" period from 2000 to 0400. During the wet weather period, the flow reached a peak of 6 gpm. As can be seen from Table 4-13, effluent quality did not deteriorate during the storm when lime was used as the coagulant.

Table 4-13

Performance of Coagulation - Flocculation - Sedimentation during Storm Conditions[1]

Run number	8 Wet weather period		9 Preceeding dry weather period		9A Wet weather period	
Date	January 12-13, 1971		January 13, 1971		January 13-14, 1971	
Coagulant						
$Ca(OH)_2$			X		X	
$FeCl_3$	X					
Dose, mg/l	100		350		350	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	54		48		33	
Primary effluent (control)	43	22	44	9	36	0
Floc-sed effluent	80	-48	8	84	5	85
Grease, mg/l						
Influent	29		52		29	
Primary effluent (control)	26	10	33	37	26	10
Floc-sed effluent	12	59	6	89	3	90
Total suspended solids, mg/l						
Influent	152		130		87	
Primary effluent (control)	127	16	76	42	69	26
Floc-sed effluent	113	26	22	83	22	63
COD, mg/l						
Influent	420		384		255	
Primary effluent (control)	271	36	278	30.2	230	10
Floc-sed effluent	280	33	185	52	159	38
Settleable solids, ml/l/hr						
Influent	9.0		5.0		3.0	
Primary effluent (control)	0.9	90	0.25	95	< 0.1	> 99
Floc-sed effluent	0.2	98	< 0.1	> 99	< 0.1	> 99
pH						
Primary effluent (control)	-	-	8.0	-	7.1	-
Floc-sed effluent	-	-	11.0	-	11.3	-
Alkalinity, mg/l as $CaCO_3$						
Influent	-	-	112	-	68	-
Floc-sed effluent	-	-	186	-	-	-
Chloride, mg/l						
Influent	440		280		130	

[a]See Fig. 4-2.

Microstrainer Test Results

Laboratory tests were conducted to determine the potential effectiveness of microstraining for effluent polishing. Test kits were supplied by the Crane-Glenfield Company. Except for the first sample taken on January 5, 1971, all samples were composites. As can be seen from the table, microstraining was only marginally effective in terms of reducing effluent turbidity. The data also provide an approximate particle size classification. In all cases the largest fraction of effluent turbidity was less than about 23 *u* in size. (Table 4-14).

Filter Backwash Requirements

Filter backwash requirements are summarized in Table 4-15 for runs 10-13. Better operational control exercised in runs 11-13 allowed backwash water to be reduced to an average of 10 percent of the water filtered.

Sludge Yield and Thickening

The jar test data were utilized to determine sludge yields as a result of coagulant addition. This was accomplished by determining the suspended solids of the coagulated sample in the jar test. Results for total sludge yield and yield due to coagulant are reported in Table 4-16.

Chemical sludge yields for lime determined from the jar tests were very much lower than those predicted from stoichiometric and equilibrium considerations[10, 11]. The amount of chemical sludge precipitate is a function of the dose and raw sewage quality. Coagulant sludge yields from the jar tests ranged from 0.4 to 0.6, while computed yields from theory ranged from 0.8 to 1.7 depending on raw waste quality and dose. It is believed that the jar test data is not representative as equilibrium is not reached: With lime sludge recycle, it is expected that the plant would approach equilibrium[12] and therefore, the theoretical yields were used for cost analysis purposes in Chapter 6.

Waste sludge was sampled at approximate peak flow (11:00 A. M.) and subsidence tests were conducted in 1000 ml graduated cylinders (Table 4-17). Higher sludge densities in terms of a sludge volume index were obtained with lime than with ferric, except during run 12 where the polymer caused enhanced compaction of the ferric sludge.

Table 4-14

Microstrainer Test Results

Date	Source	Run	Turbidity of Filtrate, JTU			
			Unfiltered	60 μ (Mark II)	35 μ (Mark I)	23 μ (Mark 0)
1/5/71	Lime clarified effluent	4	9.5	9.5	6.5	6.0
1/6/71	Lime clarified effluent	5	4.5	4.7	4.1	3.4
1/7/71	Lime clarified effluent	6	32	29	28	24
1/8/71	Lime clarified effluent	7	14	12	12	9
1/13/71	Ferric clarified effluent	8	85	85	84	80
1/13/71	Primary effluent	8	45	44	44	40
1/14/71	Lime clarified effluent	9	8.9	8.6	8.0	7.5
1/14/71	Primary effluent	9	48	48	48	45
1/15/71	Ferric clarified effluent	10	25	26	25	25
1/15/71	Primary effluent	10	32	32	32	31
1/20/71	Ferric clarified effluent	12	28	27	27	26
1/20/71	Primary effluent	12	34	34	32	29

Table 4-15

Summary of Filter Backwash Requirements[a]

Date	Run	Backwash time	Backwash duration min	Backwash volumn gal	Total vol per run	Percent backwash water
1/14/71	10	1530	7	210		
		1918	9	270		
1/15/71		0840	2	60		
		1130	2	60	600	17
1/15/71	11	1310	2	60		
		1600	2	60		
		1930	2	60		
1/16/71		100	2	60		
		600	2	60		
		1000	2	60		
		1200[b]	2	60	420	12
1/16/71	12	1420	2	60		
		2040	2	60		
1/17/71		0400	2	60		
		1030	2	60	240	7
1/17/71	13	1330	2	60		
		1530	2	60		
		2100	2	60		
		0245	2	60		
		0930	2	60		
		1200	2	60	360	11

[a]Filter backwashed when head over sand reached 4 feet

[b]Max head loss not achieved at this point

Table 4-16

Chemical Sludge Yield by Jar Test

Date	Run	Coagulant	(1) Dose mg/l	(2) TSS raw sewage mg/l	(3) TSS coagulated sample mg/l	Chemical sludge yield ((3)-(2))/(1)	Total sludge yield (3)/(1)
12/29/70	1	$Ca(OH)_2$	300	140	258	0.39	0.86
12/30/70	2	$Ca(OH)_2$	300	150	374	0.75	1.25
1/5/70	4	$Ca(OH)_2$	350	110	388	0.79	1.10
1/6/70	5	$Ca(OH)_2$	200	110	230	0.60	1.15
1/8/70	7	$FeCl_3$	100	166	248	0.82	2.48
1/13/71	8	$FeCl_3$	100	152	173	0.21	1.73
1/14/71	9	$FeCl_3$	150	130	244	0.76	1.63
1/15/71	10	$FeCl_3$	150	120	246	0.84	1.64

Table 4-17

Sludge Thickening and Loading Data for Lime and Ferric Sludges

Run number	1	2	3	4
Date	Dec. 28-29, 1970	Dec. 29-30, 1970	Dec. 30-31, 1970	Jan. 4-5, 1971
Coagulant				
$Ca(OH)_2$	X	X	X	X
$FeCl_3$				
Dose, mg/l	300	350	350	350
Wasting				
Minutes per hour	4	4	4	4
Approximate flow rate, gpm	0.85	0.85	0.85	0.85
Volume, gallons	82	82	82	82
Sludge thickening column test[b] (peak flow sample)				
Total suspended solids, mg/l	c	c	46,000	19,000
Volume after 30 minutes, ml	c	c	c	1,000
Time to reach 500 ml, hour	c	c	c	c
Volume after 24 hours, ml	c	c	c	780
Sludge volume index, ml/gram	c	c	c	41

Run number	5	6	7
Date	Jan. 5-6, 1971	Jan. 6-7, 1971	Jan. 7-8, 1971
Coagulant			
$Ca(OH)_2$	X	X	X
$FeCl_3$			
Dose, mg/l	350	175	250
Wasting			
Minutes per hour	8	8	8
Approximate flow rate, gpm	0.85	0.85	0.85
Volume, gallons	164	164	164
Sludge thickening column test[b] (peak flow sample)			
Total suspended solids, mg/l	15,370	8,300	11,555
Volume after 30 minutes, ml	1,000	970	c
Time to reach 500 ml, hours	c	c	c
Volume after 24 hours, ml	610	360	c
Sludge volume index, ml/gram	40	43	c

Run number	10	11	12	13
Date	Jan. 14-15, 1971	Jan. 18-19, 1971	Jan. 19-20, 1971	Jan. 20-21, 1971
Coagulant				
$Ca(OH)_2$				
$FeCl_3$	X	X	X	X
Dose, mg/l	150	150	100[a]	150
Wasting				
Minutes per hour	16	8	8	8
Approximate flow rate, gpm	0.85	0.85	0.85	0.85
Volume, gallons	328	164	164	164
Sludge thickening column test[b] (peak flow sample)				
Total suspended solids, mg/l	3,100	3,968	4,300	4,160
Volume after 30 minutes, ml	210	900	630	850
Time to reach 500 ml, hours	1.1	3	.75	2.5
Volume after 24 hours, ml	210	370	180	480
Sludge volume index, ml/gram	68	93	42[d]	115

[a]Dow A-23: 0.9 mg/l.

[b]All tests in 1000 ml graduated cylinder.

[c]Observation not taken.

[d]Note better compaction with polymer.

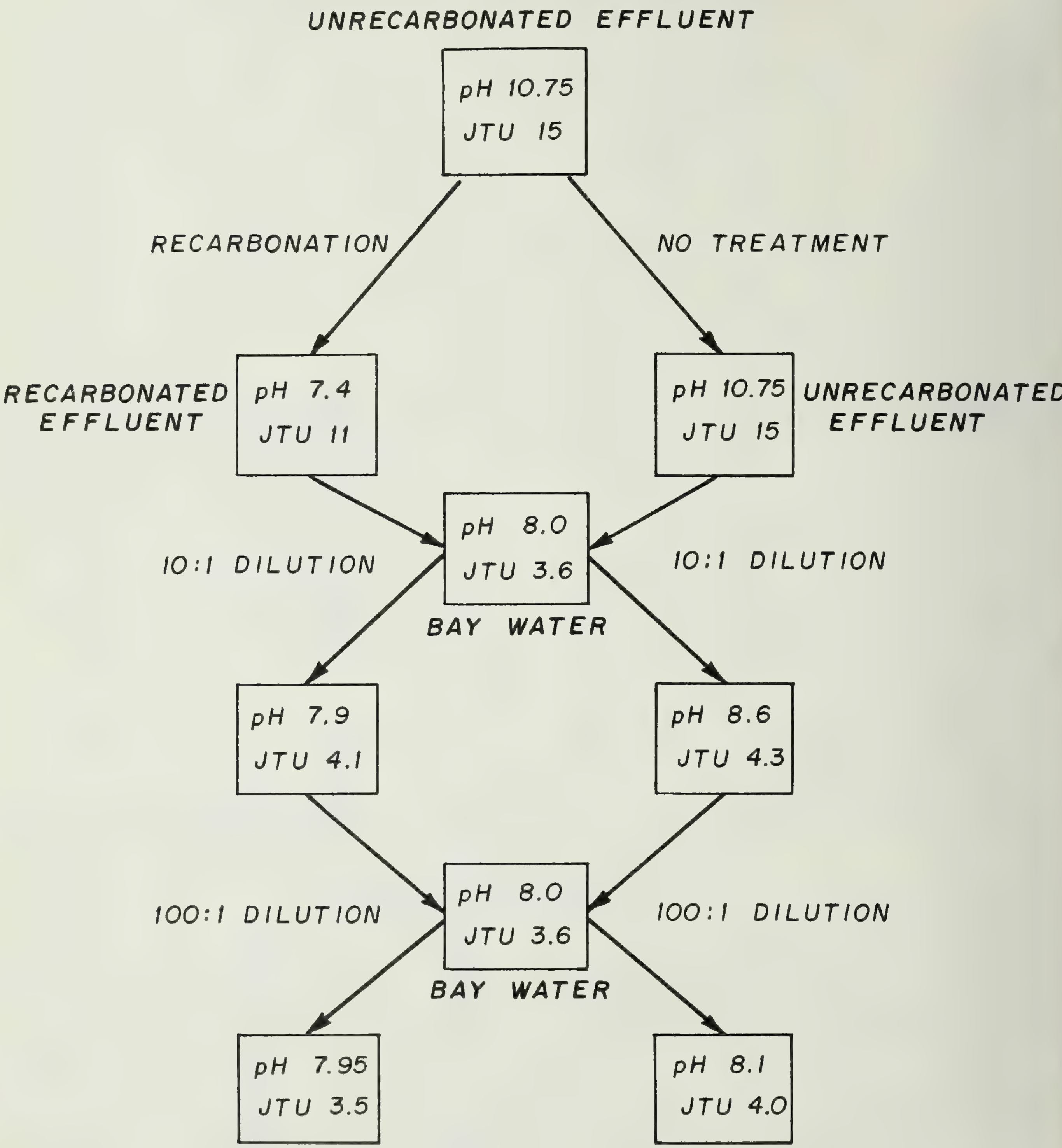


Figure 4-7

Recarbonation Experiment - Study I

Recarbonation Studies

Recarbonation (CO_2 addition) to neutral pH is frequently employed to reduce effluent pH after the use of lime. Recarbonation in this manner will usually dissolve the finely divided precipitates that were not removed by sedimentation and will consequently anhance effluent clarity. However, recarbonation may not be necessary if sufficient effluent dilution is provided. If effluent and receiving waters are rapidly mixed in the proper proportions, the pH of the mixture may be such that no post precipitation of $CaCO_3$ will occur and indeed any precipitate remaining in the effluent may be dissolved.

To determine the need for recarbonation, dilution studies were conducted in the laboratory to simulate the conditions which would take place in an effluent field with a recarbonated and unrecarbonated effluent.

A typical computer analysis for initial dilution at the North Point outfall indicated that a 10:1 dilution will be obtained in two sec followed by 100:1 dilution in 70 sec. These rates were simulated in the laboratory by titrating a bay water sample into a sample of recarbonated and unrecarbonated effluent.

The basic experiment was conducted twice and the results are displayed in Fig. 4-7 and 4-8. As can be seen from the figures, there is little difference in turbidity and pH in the 100:1 dilutions of recarbonated or unrecarbonated samples. Consequently, the discharge of unrecarbonated effluent appears feasible from a pH standpoint. However, effluent chlorination is not effective at high pH and insufficient coliform kill is attained due to high pH alone. This necessitates recarbonation and chlorination where coliform kill is required.

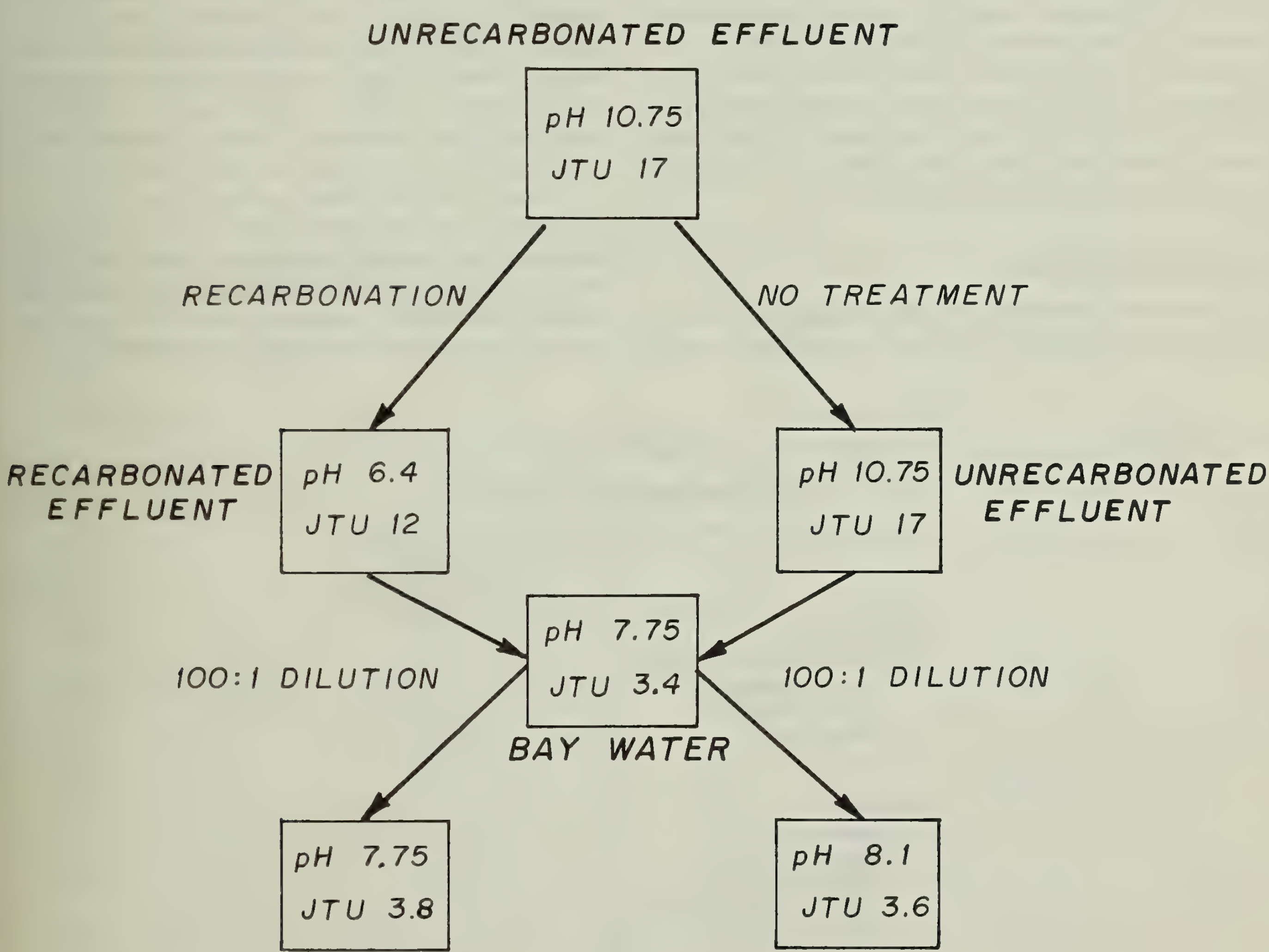


Figure 4-8

Recarbonation Experiment - Study II

COAGULATION-FLOCCULATION-FLOTATION

Flotation is an attractive unit process because performance equivalent to that obtained by sedimentation is achievable at overflow rates several times that employed with sedimentation. Where land costs are excessive, such an advantage can make flotation competitive with sedimentation.

A rental flotation unit was used in the flotation studies. The rapid mix chamber in the main pilot facility was used for flocculation. Chemical coagulants (lime or ferric) were added in-line on the suction side of the influent pump. The main pilot facility was used when a primary effluent was desired as the influent to the flotation test sequence.

Since float collection was by hand, the rental flotation unit was more suited to short term experiments than the 24-hr studies conducted in the previous phase. Due to the short residence time in the unit, (15 minutes at 1 gpm/sq ft), the experiments were conducted for only one hr each and from three to five runs were made per day. Unit process operating criteria are presented in Table 4-18.

Process Performance

Process performance was monitored using the same analytical methods as employed with the coagulation-flocculation-sedimentation test sequences.

Routine Analyses. Performance data for those waste constituents analyzed routinely are presented in Tables 4-19, 4-20 and 4-21 for flotation without chemicals, flotation with lime, and flotation with ferric chloride.

Performance obtained without chemicals (Table 4-19) with raw sewage (runs 16-18) was approximately equivalent to that obtained with primary sedimentation. However, higher grease removals appear attainable with flotation than with primary sedimentation. Flotation following sedimentation (runs 14 and 15) did achieve some additional improvement, but did not meet the severest effluent criteria.

Lime and ferric proved to be about equally effective coagulants in flotation (Tables 4-20 and 4-21). As would be expected, performance tended to decrease with overflow rate, particularly as the rate approached 3 gpm/sq ft. Even at 2 gpm/sq ft, the severest effluent turbidity and grease criteria could not be reliably attained. The settleable solids criteria were exceeded at the 3 gpm/sq ft overflow rate.

Based on he data gathered to date on flotation, it would appear that flotation process efficiency is highly correlated with overflow rate and that the severest effluent c criteria may not be dependably attained even at 2 gpm/sq ft overflow rate without effluent polishing.

Table 4-18

Flotation Operating Criteria[a]

	Flow Rates		
	1 gpm	2 gpm	3 gpm
Flocculation			
(With chemical addition only)			
Volume, gallons	11.6	11.6	11.6
Detention, minutes	11.6	5.8	3.9
Paddle, rpm	60	60	60
G, sec^{-1}	100	100	100
Flotation			
Volume, gallons	15	15	15
Detention, minutes[b]	15	7.5	5
Surface area, sq ft	1	1	1
Surface loading, gpm/sq ft[b]	1	2	3
Percent recycle	40	40	40

[a]Grit removal preaeration, sedimentation criteria as in previous model.

[b]Not including recycle.

Table 4-19

Flotation Performance without Chemical Addition

Run number	14		15	
Date	January 22, 1971		January 22, 1971	
Overflow rate, gpm/sq ft	2		1	
Influent				
Raw				
Settled sewage	X		X	
	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU				
Influent	39		39	
Effluent	34	12.8	31	20.5
Grease, mg/l				
Influent	a		a	
Effluent				
Total suspended solids, mg/l				
Influent	77		67	
Effluent	45	42	31	54
COD, mg/l				
Influent	132		140	
Effluent	98	26	94	26
Settleable solids, ml/l/hr				
Influent	a		a	
Effluent				
Alkalinity, mg/l as $CaCO_3$				
Influent	a		a	
Effluent				
pH				
Effluent	a		a	

Run number	16		17		18	
Date	January 22, 1971		January 22, 1971		January 22, 1971	
Overflow rate, gpm/sq ft	1		0.5		2	
Influent						
Raw	X		X		X	
Settled sewage						
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	100		90		80	
Effluent	58	42	58	35	50	37.5
Grease, mg/l						
Influent	105		74		61	
Effluent	34	67	29	61	40	34
Total suspended solids, mg/l						
Influent	250		210		150	
Effluent	90	64	94	55	74	50.5
COD, mg/l						
Influent	596		570		536	
Effluent	258	40	426	25	391	27
Settleable solids, ml/l/hr						
Influent	7		9		9	
Effluent	<0.1	>99	<0.1	>99	<0.1	>99
Alkalinity, mg/l as $CaCO_3$						
Influent	117		134		142	
Effluent	126		130		143	
pH						
Effluent	6.7		6.9		7.0	

[a]Not available.

Table 4-20

Flotation Performance with Lime Addition

Run number	25		26		27	
Date	January 27, 1971		January 27, 1971		January 27, 1971	
Overflow rate, gpm/sq ft	2		3		1	
Influent						
Raw						
Settled sewage	X		X		X	
Lime dose as $Ca(OH)_2$, mg/l	150		150		150	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	54[b]		72[b]		84[b]	
Effluent	24	56[b]	19	74[b]	16	81[b]
Grease, mg/l						
Influent	a		a		a	
Effluent	a		a		a	
Total suspended solids, mg/l						
Influent	130[b]		180[b]		230[b]	
Effluent	67	49[b]	45	75[b]	37	84[b]
Volatile suspended solids, mg/l						
Influent	82		100		130	
Effluent	46	44	24	76	27	79
COD, mg/l						
Influent	308		324		349	
Effluent	221	28	212	35	222	36
Settleable solids, ml/l/hr						
Influent	0.8[b]		6.5[b]		7.8[b]	
Effluent	< 0.1	b	< 0.1	b	< 0.1	b
Alkalinity as $CaCO_3$, mg/l						
Influent	200[b]	-	233[b]	-	248[b]	
Effluent	206	-	227	-	228	
pH						
Effluent	8.2		8.4		8.4	
Chloride, mg/l	1106					

Run number	28		29		30	
Date	January 28, 1971		January 29, 1971		January 30, 1971	
Overflow rate, gpm/sq ft	1		2		3	
Influent						
Raw						
Settled sewage	X		X		X	
Lime dose as $Ca(OH)_2$, mg/l	275		275		275	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	45		50		52	
Effluent	5	89	5	90	26	50
Grease, mg/l						
Influent	a		a		a	
Effluent	a		a		a	
Total suspended solids, mg/l						
Influent	96		110		120	
Effluent	14	83	22	80	91	24
Volatile suspended solids, mg/l						
Influent	84		98		100	
Effluent	12	86	15	85	71	29
COD, mg/l						
Influent	319		339		355	
Effluent	155	51	130	62	201	43
Settleable solids, ml/l/hr						
Influent	0.7		1.0		0.8	
Effluent	< 0.1	> 86	< 0.1	> 90	0.5	62
Alkalinity as $CaCO_3$, mg/l						
Influent	124		130		126	
Effluent	277		294		220	
pH						
Effluent	10.0		10.5		10.7	
Chloride, mg/l	1216					

[a] Analysis suspect.

[b] Influent sample taken after chemical addition, analysis affected.

Table 4-20 (Continued)
Flotation Performance with Lime Addition

Run number	31		32		33	
Date	February 3, 1972		February 3, 1972		February 3, 1972	
Overflow rate, gpm/sq ft	1		2		3	
Influent						
Raw	X		X		X	
Settled sewage						
Lime dose as $Ca(OH)_2$, mg/l	350		350		350	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	73		74		82	
Effluent	7.8	93	23	69	36	56
Grease, mg/l						
Influent	59		64		68	
Effluent	4	93	11	83	14	79
Total suspended solids, mg/l						
Influent	220		300		200	
Effluent	18	92	80	73	58	71
Volatile suspended solids, mg/l						
Influent	180		180		160	
Effluent	9	95	42	77	58	64
COD, mg/l						
Influent	486		621		552	
Effluent	166	66	254	59	276	50
Settleable solids, ml/l/hr						
Influent	10		12		6	
Effluent	<0.1	>90	<0.3	>88	1.2	80
Alkalinity as $CaCO_3$, mg/l						
Influent	160		151		134	
Effluent	280		284		287	
pH						
Effluent	10.5		10.7		10.7	
Chloride, mg/l	995					

Run number	38		39		40	
Date	February 5, 1971		February 5, 1971		February 5, 1971	
Overflow rate, gpm/sq ft	1		2		3	
Influent						
Raw						
Settled sewage	X		X		X	
Lime dose as $Ca(OH)_2$, mg/l	275		275		275	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	31		46		54	
Effluent	4.8	84	6.6	86	18	67
Grease, mg/l						
Influent	26		32		38	
Effluent	10	62	4	87	9	76
Total suspended solids, mg/l						
Influent	67		85		130	
Effluent	10	85	12	86	61	53
Volatile suspended solids, mg/l						
Influent	44		51		71	
Effluent	10	77	10	80	46	35
COD, mg/l						
Influent	221		323		424	
Effluent	109	51	170	47	222	48
Settleable solids, ml/l/hr						
Influent	<0.1		0.35		2	
Effluent	<0.1		<0.1	>72	0.7	65
Alkalinity as $CaCO_3$, mg/l						
Influent	118		157		145	
Effluent	261		[a]		227	
pH						
Effluent	10.1		10.4		10.3	
Chloride, mg/l			1410			

[a] Analysis suspect.

[b] Influent sample taken after chemical addition, analysis affected.

Table 4-21

Flotation Performance with Ferric Chloride Addition

Run number	19		20		21	
Date	January 25, 1971		January 25, 1971		January 25, 1971	
Overflow rate, gpm/sq ft	2		3		1	
Influent						
Raw						
Settled sewage	X		X		X	
Ferric dose, mg/l as $FeCl_3$	150		150		150	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	79[b]		94[b]		94[b]	
Effluent	16	80[b]	14	75[b]	6	94[b]
Grease, mg/l						
Influent	a		a		a	
Effluent	a		a		a	
Total suspended solids, mg/l						
Influent	200[b]		260[b]		280[b]	
Effluent	45	77[b]	30	89[b]	17	94[b]
Volatile suspended solids, mg/l						
Influent	140	150	150		150	
Effluent	34	76	20	87	12	92
COD, mg/l (or BOD)						
Influent	396		525		433	
Effluent	313	21	194	63	177	59
Settleable solids, ml/l/hr						
Influent	3.5[b]		37[b]		39[b]	
Effluent	< 0.1	> 97	< 0.1	> 99	< 0.1	> 99
Alkalinity, mg/l as $CaCO_3$						
Influent	108[b]		24[b]		30[b]	
Effluent	55		31		25	
pH						
Effluent	6.5		6.2		6.1	
Chlorides, mg/l	1500					

Run number	22		23		24	
Date	January 26, 1971		January 26, 1971		January 26, 1971	
Overflow rate, gpm/sq ft	1		2		3	
Influent						
Raw						
Settled sewage	X		X		X	
Ferric dose, mg/l a as $FeCl_3$	75		75		75	
	Concentration	Removal, percent	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU						
Influent	51[b]		53[b]		60[b]	
Effluent	7.3	86[b]	10	81[b]	35	42[b]
Grease, mg/l						
Influent	a		a		a	
Effluent	a		a		a	
Total suspended solids, mg/l						
Influent	180[b]		210[b]		120[b]	
Influent	12	93[b]	22	89.4[b]	120	0[b]
Volatile suspended solids, mg/l						
Influent	130		140		94	
Effluent	10	92	17	88	56	40
COD, mg/l (or BOD))						
Influent	272		317		369	
Effluent	115	58	154	51	233	37
Settleable solids, ml/l/hr						
Influent	21[b]		20[b]		17[b]	
Effluent	<0.1	> 99	< 0.1	> 99	3.5	85
Alkalinity, mg/l as $CaCO_3$						
Influent	69[b]		72[b]		72[b]	
Effluent	64		65		74	
pH						
Effluent	6.5		6.8		6.8	
Chlorides, mg/l			1270			

[a] Analysis suspect.

[b] Influent sample taken after chemical addition; analysis affected.

Table 4-21 (Continued)

Flotation Performance with Ferric Chloride Addition

Run number	34		35	
Date	February 4, 1971		February 4, 1971	
Overflow rate, gpm/sq ft	1		2	
Influent				
Raw	X		X	
Settled sewage				
Ferric dose, mg/l as $FeCl_3$	150		150	
	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU				
Influent	71		90	
Effluent	4.2	94	21	77
Grease, mg/l				
Influent	50		59	
Effluent	9	82	4	93
Total suspended solids, mg/l				
Influent	230		230	
Effluent	9	96	63	70.5
Volatile suspended solids, mg/l				
Influent	190		190	
Effluent	6	97	42	78
COD, mg/l (or BOD)				
Influent	499		528	
Effluent	146	71	227	57
Settleable solids, ml/l/hr				
Influent	11[b]		13.5	
Effluent	< 0.1	> 99	2.5	82
Alkalinity, mg/l as $CaCO_3$				
Influent	137		132	
Effluent	35		39	
pH				
Effluent	6.5		6.4	
Chlorides, mg/l				

Run number	36		37	
Date	February 4, 1971		February 4, 1971	
Overflow rate, gpm/sq ft	1		2	
Influent				
Raw				
Settled sewage	X		X	
Ferric dose, mg/l as $FeCl_3$	150		150	
	Concentration	Removal, percent	Concentration	Removal, percent
Turbidity, JTU				
Influent	62		63	
Effluent	7.8	93	27	57
Grease, mg/l				
Influent	48		48	
Effluent	15	69	10	79
Total suspended solids, mg/l				
Influent	58		110	
Effluent	17	71	56	49
Volatile suspended solids, mg/l				
Influent	44		85	
Effluent	8	82	33	61
COD, mg/l (or BOD)				
Influent	383		391	
Effluent	52	60	206	47
Settleable solids, ml/l/hr				
Influent	1.2		1	
Effluent	< 0.1	> 92	< 0.4	> 96
Alkalinity, mg/l as $CaCO_3$				
Influent	134		153	
Effluent	41		27	
pH				
Effluent	6.4		6.4	
Chlorides, mg/l	870			

[a]Analysis suspect.

[b]Influent sample taken after chemical addition; analysis affected.

Color Removal. Using methods described previously, absorbance spectra were determined for flotation influents and effluents (Fig. 4-9 and 4-10). Both ferric and lime were effective in reducing effluent color.

The results of color chromaticity analysis of these spectra (Tables 4-22 and 4-23) indicate that the only chromaticity parameter of significance is the luminance, due to the low purity of the color. In both cases, there is less color (higher luminance) in the flotation effluent than in the bay water sample. (Table 4-8).

Toxicity Removal. As before, chemical coagulation enhanced toxicity removal (Table 4-24). Lime seemed to be somewhat more effective in this respect, as 100 percent survival was attained in the undiluted effluent.

BOD Removal. BOD removal efficiencies are presented in Table 4-24 with COD data for comparison purposes.

MBAS. Surfactants, as measured by the MBAS test, were only partially removed with flotation (Table 4-24).

Floatables. Flotation proved effective in floatable solids removal when ferric was employed. While no data was obtained with lime, it is reasonable to expect that high floatable removal would be obtained, as high removals were obtained with lime in the sedimentation studies. (Table 4-24).

Figure 4-9

True Color of Influents and Effluents with Ferric Flotation (Run 35)

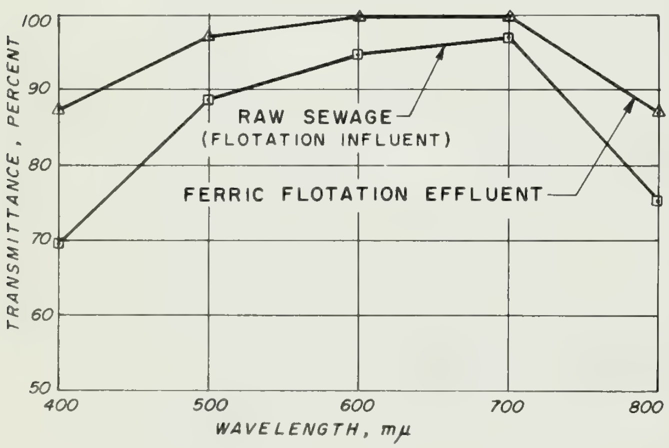


Figure 4-10

True Color of Influents and Effluents with Lime Flotation (Run 29)

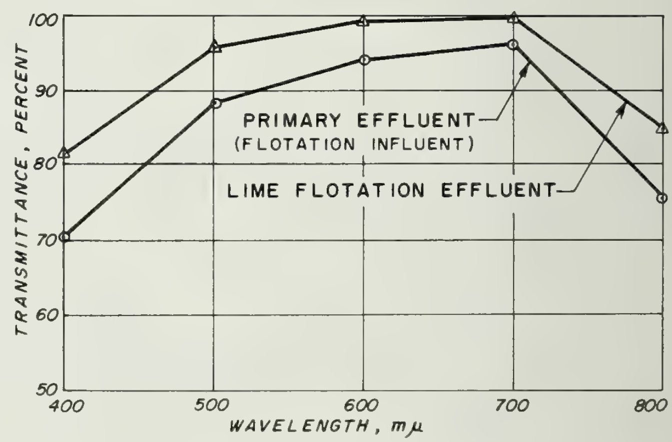


Table 4-22

Summary of Color Chromaticity Analysis of Influents and Effluents during Flotation with Ferric Chloride (Run 35)

	Source	
	Raw sewage	Ferric flotation
Dominant wavelength, mμ	580	570
Purity, percent	8	3
Hue	Yellow	Yellow
Luminance, percent	92	98.5

Table 4-23

Summary of Color Chromaticity Analysis of Influent and Effluents during Flotation with Lime (Run 29)

	Source	
	Primary effluent	Lime flotation effluent
Dominant wavelength,	580	570
Purity, percent	7	5
Hue	yellow	Green-yellow
Luminance, percent	91	97

Table 4-24

Special Analyses for Coagulation - Flocculation - Flotation

Effluent and run description	Survival in undiluted effluent after 96 hr, percent	Median tolerance limit(TLm) percent	BOD		COD		MBAS		Floatables	
			mg/l	Removal, percent	mg/l	Removal, percent	mg/l	Removal, percent	mg/l	Removal, percent
Run 29 - Lime										
Influent (primary)	20	84	130		339		1.8		a	
Flotation effluent	100	> 100	92	29	130	62	0.8	55	a	a
Run 35 - Ferric										
Influent (raw)		52	220		528	1.1			1.6	
Flotation effluent	50	100	86	61	227	57	0.73	36	0.3	81

[a]Not available.

Table 4-25

Summary of Lead Removal with Flotation of Raw Sewage

Run	31	32	33	34	35
Date	2/3/71	2/3/71	2/3/71	2/4/71	2/4/71
Flotation					
Overflow rate., gpm/sq ft	1	2	3	1	2
Coagulant dose, mg/l					
Lime ($Ca(OH)_2$	350	350	350		
Ferric ($FeCl_3$)				150	150
Pb concentration, mg/l					
Influent	0.098	0.133	0.128	0.11	0.15
Float effluent	0.013	0.010	0.042	0.02	0.04
Primary effluent (Control)	0.049	0.045	0.116	0.03	0.04
Pb removals, percent					
Flotation	76	93	67	82	73
Primary treatment	50	66	10	72	73

Lead Removal. Lime appeared to be somewhat more effective in removing lead than ferric chloride, as is indicated in Table 4-25.

Float Production

Characteristics of the float collected during each run are reported in Table 4-26. Better float concentration was obtained when lime was used as the coagulant than when ferric chloride was employed.

SUMMARY OF FINDINGS

The use of the City's advanced waste treatment pilct facility at North Point allowed the evaluation of the effectiveness of several waste treatment schemes in terms of meeting effluent and receiving water criteria suggested or required by the San Francisco Bay Regional Water Quality Control Board. Results of this study can be conveniently divided between the two treatment test sequences evaluated.

Table 4-26

Float Production with Flotation

Date	Run	Coagulant		Overflow rate, gpm/sq ft	Sewage		Float volume, liters[a]	Collapsed volume, liters[a]	Total solids of collapsed float, percent	Collection period, hours	Float generation rate, lbs/day[c]
		Type	Dose, mg/l		Raw	Primary					
1971											
Jan. 22	14	none		2		X	0.75	0.2	0.63	1.08	0.06
Jan. 22	15	none		1		X	0.57	0.12	2.5	1.08	0.15
Jan. 22	16	none		1	X		0.94	0.55	2.3	1.0	0.67
Jan. 22	17	none		0.5	X		0.75	0.50	4.9	1.0	1.29
Jan. 22	18	none		2	X		0.94	0.80	8.5	1.08	3.3
Jan. 25	19	$FeCl_3$	150	2	X	X	11.4	3.4	2.6	1.0	4.7
Jan. 25	20	$FeCl_3$	150	3		X	13.3	5.7	2.3	~ 1.0	6.8
Jan. 25	21	$FeCl_3$	150	1		X	5.3	1.9	2.5	~1.0	2.5
Jan. 26	22	$FeCl_3$	75	1		X	0.76	0.76	2.7	1.0	1.08
Jan. 26	23	$FeCl_3$	75	2		X	1.9	1.9	2.6	1.0	2.6
Jan. 26	24	$FeCl_3$	75	3		X	2.3	2.3	2.7	1.0	3.3
Jan. 27	25	$Ca(OH)_2$	150	2		X	0.57	0.40[b]	5.2	1.0	1.1
Jan. 27	26	$Ca(OH)_2$	150	3		X	0.95	0.67[b]	5.6	1.0	2.0
Jan. 27	27	$Ca(OH)_2$	150	1		X	0.45	0.32[b]	4.7	1.0	0.80
Jan. 28	28	$Ca(OH)_2$	275	1		X	0.76	0.57	4.5	1.08	1.25
Jan. 28	29	$Ca(OH)_2$	275	2		X	2.3	1.5	4.6	1.0	3.65
Jan. 28	30	$Ca(OH)_2$	275	3		X	5.7	3.8	4.3	1.0	8.8
Feb. 3	31	$Ca(OH)_2$	350	1	X		1.9	1.1	4.4	1.0	2.5
Feb. 3	32	$Ca(OH)_2$	350	2	X		2.85	2.3	5.3	1.0	6.2
Feb. 3	33	$Ca(OH)_2$	350	3	X		3.8	3.0	4.8	1.08	7.0
Feb. 4	34	$FeCl_3$	150	1	X		2.5	1.9	3.4	1.08	3.2
Feb. 4	35	$FeCl_3$	150	2	X		3.8	3.0	3.6	1.08	5.3
Feb. 4	36	$FeCl_3$	150	1		X	1.9	0.76	2.9	1.0	1.2
Feb. 4	37	$FeCl_3$	150	2		X	7.4	3.7	2.4	1.0	4.7
Feb. 5	38	$Ca(OH)_2$	275	1		X	0.56	0.40[b]	5.4	0.92	1.2
Feb. 5	39	$Ca(OH)_2$	275	2		X	2.65	1.90[b]	4.3	0.92	4.7
Feb. 5	40	$Ca(OH)_2$	275	3		X	4.9	3.5[b]	4.2	1.0	8.4

[a]Collapsed volume measured after 24 hours.

[b]Volume not measured but proportioned from Runs 28-33; collapsed volume = 0.71 (initial volume).

[c]One hour operation extrapolated to 24 hours; transient effect may cause underestimation of daily rate; dry solids basis.

Coagulation-Flocculation-Sedimentation

Findings of this phase of the investigation are summarized as follows:

1. Effective grease removal can be attained with either lime or ferric chloride as the main coagulant.
2. The severest effluent criteria can be obtained with the use of the coagulation-flocculation-sedimentation treatment sequence when lime is employed as the coagulant. When ferric salt is used, effluent polishing by sand filtration must be employed to achieve similar performance.
3. The effectiveness of ferric salt as a coagulant appears to be reduced by the conditions of turbulence in the preaeration basin. Milder turbulence might allow better performance to be obtained.
4. The use of polymers as coagulant aids may allow the main coagulant dose to be reduced and result in improved sludge thickening in the primary tanks.
5. Both lime and ferric salt proved to be effective in the removal of color. Luminance of the sedimentation tank effluent was greater than that of a bay water sample collected near North Point in November, indicating that the effluents contained less color than the receiving water sample.

6. Both lime and ferric chloride were effective in terms of reducing effluent toxicity.
7. Pilot scale performance compared favorably to performance of the North Point plant under similar operating conditions.
8. Lime seemed more effective than ferric salt under storm flows conditions in terms of maintaining effluent quality.
9. Based on the laboratory studies, microstraining appears only marginally effective in terms of reducing effluent turbidity.
10. Greater sludge compaction was obtained with the lime sludge than with the ferric sludge.
11. The discharge of lime-clarified effluent without recarbonation appears to be feasible.
12. Approximately 60 percent COD removal and 70 percent BOD removal can be attained with effluent solids separation after coagulation and flocculation.

Coagulation-Flocculation-Flotation

The findings of the coagulation-flocculation-flotation phase are as follows:

1. Lime and ferric salts proved to be about equally effective coagulants in flotation.
2. Even with an overflow rate as low as 2 gpm/sq ft, the severest effluent turbidity and grease criteria were not always obtained. Flotation process efficiency is related to overflow rate.
3. Both lime and ferric were effective coagulants in flotation in terms of color and toxicity removals.
4. Lime appeared to be somewhat more effective than ferric salt in removing lead.
5. Better float concentration was attained with lime than with ferric chloride.

RECOMMENDATIONS

Based on the findings of this investigation it is recommended that the following areas be evaluated by use of the pilot facility:

1. Further effort should be concentrated on the use of polymers as coagulant aids for the purpose of reducing main coagulant dose, improving sludge concentration, and reducing floc breakup.
2. A comparison should be made of mechanical flocculation with paddles versus the present practice of utilizing mild aeration to enhance the effectiveness of ferric salt as a coagulant.
3. Since the coagulation-flocculation-sedimentation treatment sequence is limited to about 70 percent BOD removal, further study should be made of systems capable of attaining the higher BOD reduction levels that may be required for enclosed bodies of water.
4. Further study of solids handling systems should be made.
5. Sludge solids generation should be measured for representative runs when lime is employed as the primary coagulant.

CHAPTER 5

BASIS OF COST ESTIMATES

Development of a reasonable long-range program for improvements to San Francisco's water pollution control plants requires that estimates of comparative costs be prepared for construction of their proposed improvements and for the operation of these improvements. To that end, alternatives must be formulated in sufficient detail to determine their capital outlay requirements and the basic operation costs for each type of facility.

CONSTRUCTION COSTS

Construction and operating costs are based on the proposed plant improvements and on the estimated additions to treatment processes required to achieve the goals of the Regional Board. For estimating purposes, prices of comparable work were obtained from available sources of current information.[13,14] Costs of conventional and advanced treatment facilities presented in an article by Robert Smith[15] were used in developing specific cost curves. Manufacturers, suppliers of material and equipment, and local contractors were consulted on specific questions. Costs of wastewater treatment plants designed by Brown and Caldwell were relied upon heavily in developing basic costs. All costs were adjusted as deemed necessary to reflect local San Francisco conditions.

If major improvements to the City's water pollution control plants are undertaken on an accelerated basis, it may be expected that costs will increase correspondingly. Although it is difficult to estimate what the increases for accelerated construction may be, additional costs of 25 percent or more may be incurred. Another factor which will tend to lead to higher construction costs is the requirement that the treatment plants be kept in full operation during construction. Federal guidelines[5] as amended state that bypassing of untreated or partially treated wastewater during construction will not be permitted.

In considering the estimates, it is important to realize that changes during final design will alter the totals to some degree and that future changes in the cost of material, labor and equipment will cause comparable changes in costs presented herein. On the other hand, since the relative economy of alternative projects can be expected to change only slightly with an increase or decrease in general construction costs, decisions based on present comparisons should remain valid.

Construction costs can be expected to undergo long term changes in keeping with corresponding changes in the national economy. The best available barometer of these changes is the Engineering News-Record construction cost index (ENR index). It is computed from prices of structural steel, portland cement, lumber and common labor, and is based on a value of 100 in the year 1913.

As indicated by the curve on Fig. 5-1, which portrays the trend of the ENR index since 1940, nationwide construction costs have been steadily increasing for many years. This figure also shows the rate of increase of the San Francisco area ENR index which reflects the dramatic cost increases attributable to the west coast construction labor agreements of 1965 and 1968 and to recent inflationary trends affecting the cost of materials.

For the purposes of this report, estimated costs are based on a ENR index of 1700, a level which will be reached within the year. The present San Francisco area ENR index is 1687. In any event, costs used herein may be related to those at any time in the past or future by applying the rate of the then prevailing ENR index to 1700.

Construction costs include contractor's overhead and profit, but do not include engineering, construction contingencies, right-of-way, land acquisition or legal costs. Separate allowances must be made to cover these items. Prices used in preparing preliminary estimates represent average bidding conditions for many projects. For this reason, it is entirely possible

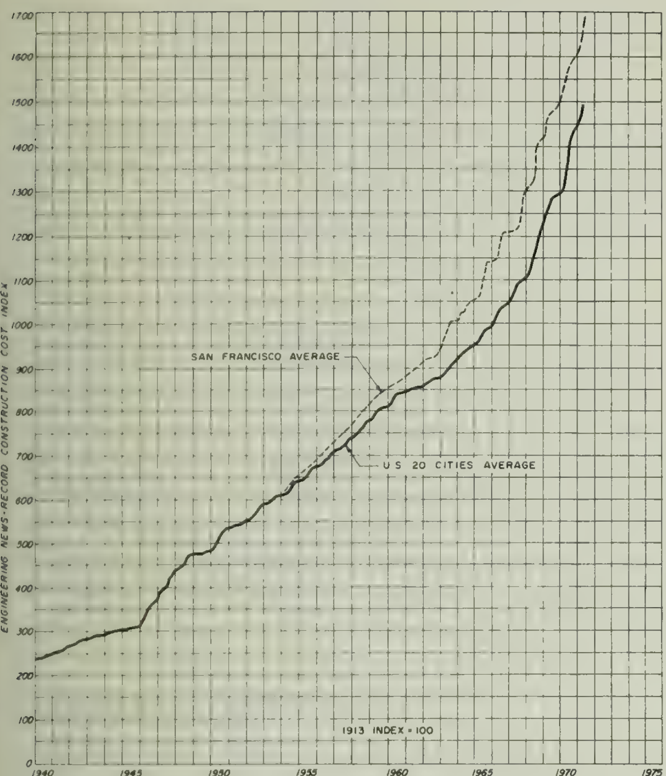


Figure 5-1

Engineering News - Record Construction Cost Index

that actual construction bids for a given project may be lower or higher than the estimated cost given herein. Although additive or deductive items are applied where believed necessary to cover special conditions, the preliminary estimates are not presumed to be as accurate as estimates prepared during final design.

Sewage Treatment Processes

Sewage treatment processes include facilities for improving the existing plants; chemical handling; coagulation and flocculation; filtration; dissolved air flotation; activated sludge and effluent pumping. Each process provides a unique degree of treatment, sometimes improving many of the vital characteristics and sometimes improving only a few. Final selection of a process combination is based on the compatibility, cost and reliable production of an acceptable effluent.

Existing Plant Improvements. Construction costs for individual improvements to the three existing water pollution control plants are based on analysis of actual unit construction costs for basic plant components under similar conditions. No attempt has been made to present improvement costs figurattively because of the individual requirements of each plant. Allowances have been made for working around operating equipment, in sewage atmospheres and in strict compliance with the federal guidelines prohibiting bypassing or the partial treatment of the wastewaters during construction.

Chemical Handling, Coagulation and Flocculation. Costs for chemical handling, coagulation and flocculation at each of the three plants are based on analysis of actual unit construction costs for equipment and structures of similar facilities in similar circumstances. Individual requirements for each type of chemical and special application conditions at each plant make it impractical to present these costs figuratively. Separate solids disposal costs are presented later in this chapter.

Filtration. Construction costs for filtration through sand or graded media are based on tabulated costs for such treatment. Filters are assumed to operate at a rate of 6 gpm/sq ft at peak flow, about three times what is considered normal for water purification plants. Costs include provisions for wash water supply, dirty water treatment and standby facilities. Filtration construction cost curve is shown on Fig. 5-2.

Dissolved Air Flotation. Construction costs for dissolved air flotation are based on published costs for such treatment.[16,17] Flotation units are assumed to be operated with a 33 to 50 percent recycle rate, a surface loading rate of 2 gpm/sq ft not including recycle flow, and an air pressure of 60 psi. Standby facilities costs are included. Flotation construction cost curve is plotted on Fig. 5-2.

Activated Sludge. Activated sludge construction costs are based on tabulated data for such treatment. Activated sludge facilities include aeration and sludge reaeration tanks and circular secondary sedimentation tanks.

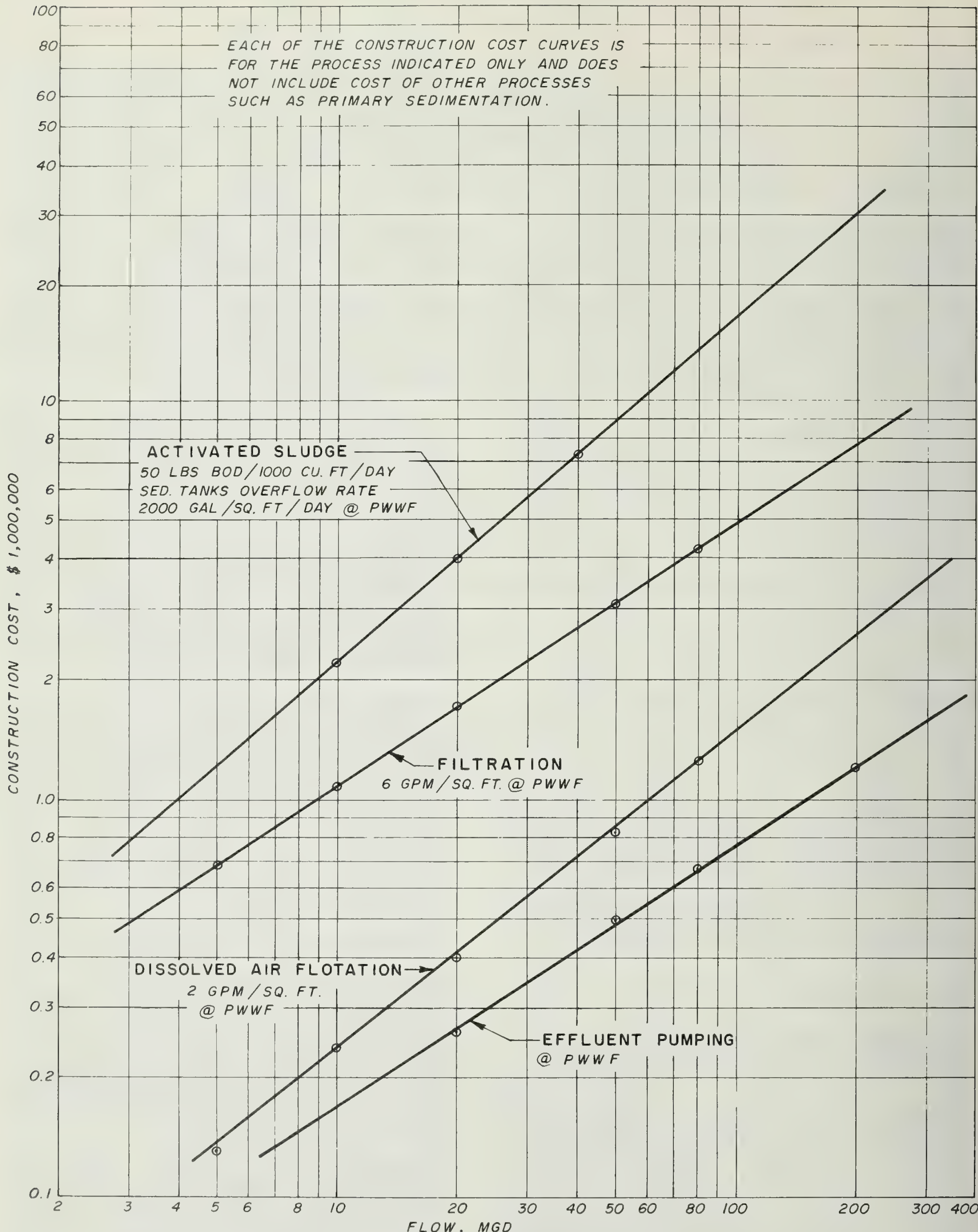


Figure 5-2

Estimated Construction Cost Curves

(Costs are based on an ENR construction cost index of 1700. Curves include the cost of basic structures, channels, major pipelines and contractor's overhead and profit but do not include land, special housings, special foundations, or engineering and contingencies.)

Aeration tanks are assumed to operate on loadings up to and including 50 lbs applied BOD/1000 cu ft/day. Standby blower and return activated sludge equipment is included. Secondary sedimentation tanks are assumed to operate at peak wet weather flow overflow rates of 2000 gal/sq ft/day. Activated sludge construction cost curve is plotted on Fig. 5-2.

Effluent Pumping Station. Costs for effluent pumping stations are based on peak rates of flow with sufficient pumping capacity to handle peak flows with one pumping unit out of service. Construction costs also make allowance for fully automatic control of pumping functions and for suitable architectural design criteria. Effluent pumping station construction cost curve is plotted on Fig. 5-2.

Solids Handling Facilities

Solids handling includes facilities for thickening, conditioning, dewatering and final disposal. Several alternatives are available in each category. For the purposes of cost estimating in this report, only one system for each alternative is used. The selection of the system is based on equipment reliability and performance and ease of operation and maintenance as determined from previous studies, field observations and literature review.[18]

Thickening. Despite the unsatisfactory results experienced at the Southeast plant, primary and lime sludge is usually more economically thickened by gravity and this method of thickening is used for estimating purposes for all except waste activated and high ferric chloride sludges. Flotation thickeners are used for estimating purposes for these lighter sludges. Gravity thickening costs are plotted against required area, expressed in square feet, and include units designed with a minimum detention of 6 hours and an overflow rate of 500 gal/sq ft/day. Dry solids loadings per sq ft vary for chemical type and dosage. Flotation thickening costs are based on units designed for an average loading of 20 lbs dry solids per sq ft and are also plotted against required area. Solids thickening construction cost curves are plotted on Fig. 5-3.

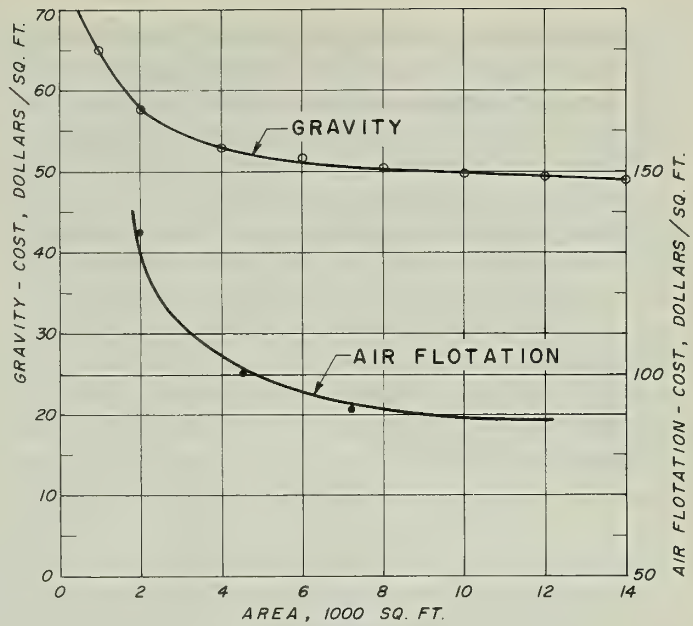


Figure 5-3

Construction Cost of Sludge Thickeners

Conditioning. Of the various methods of sludge conditioning, heat treatment seems to produce the best sludge for ease and efficiency in filter dewatering and ultimate disposal. Sludge so conditioned can be filtered and used safely either as landfill or as a fuel in a heat recovery system. Heat treatment costs include facilities which provide 30 minutes of solids detention at from 350 to 400° F and 200 psig. The cost of standby facilities is included. Solids heat treatment construction costs are plotted against gal per hour capacity, on Fig. 5-4.

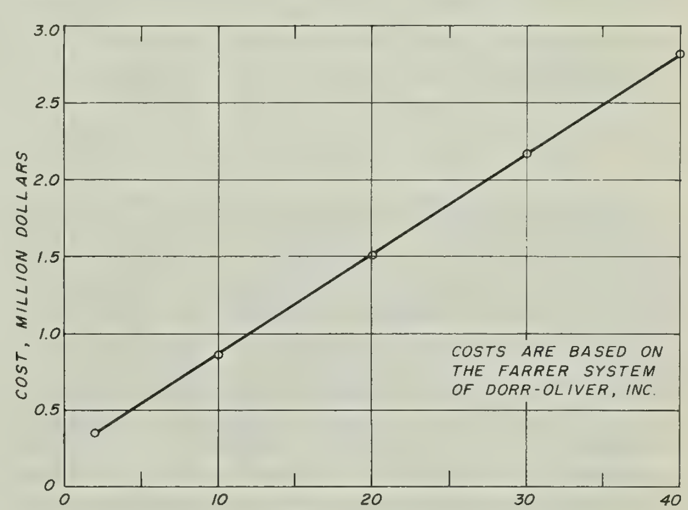


Figure 5-4

Construction cost of Sludge Conditioning by Heat Treatment

Dewatering. Existing vacuum filtration dewatering facilities have the capability of meeting the dewatering needs of some of the alternative treatment processes without major additional equipment. Some modifications and revisions to this equipment are included in existing plant improvements. Additional modifications are required for the alternatives utilizing high chemical additions. Construction costs are plotted against required filter areas, expressed in square feet, on Fig. 5-5. Filter dry solids loadings per square foot vary for the different types of conditioning and chemical treatment utilized.

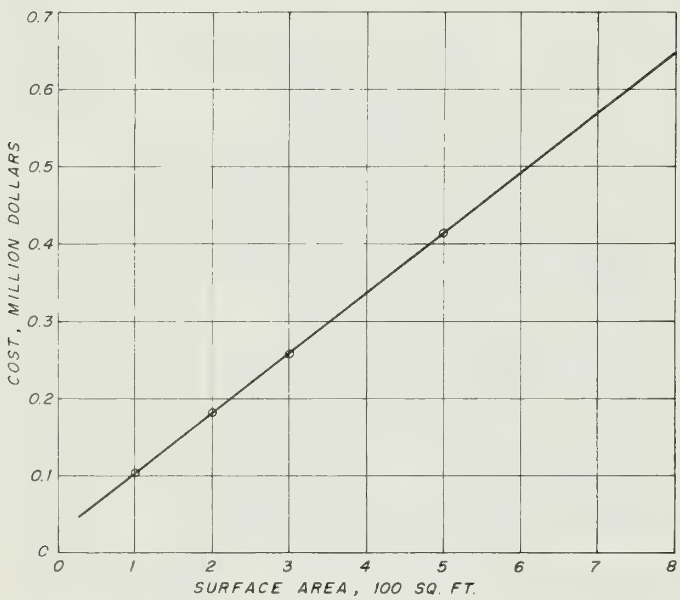


Figure 5-5

Construction cost of Sludge Dewatering by Vacuum Filtration

Electrochemical Oxidation. One of the newest and most compact means of treating the anaerobic wastes of digester supernatant, heat treatment decant and vacuum filter filtrate is accomplished through the use of electrolytic cells and air flotation. Wastes, so treated, can be disposed of to plant influent with no danger of recycling and upsetting treatment efficiency. Construction costs for this process have been established at $1100 per 1000 gal/day by the manufacturer. Operating power usage is expected to average 50 horsepower/1000 gal.

Disposal. Solids disposal costs have been investigated for both hauling and incineration. Both of these methods of disposal contain nonengineering considerations which are beyond the scope of this study, but should be included in the final consideration affecting the selected solution.

Construction costs for hauling will be little affected by the quantity of material hauled and therefore are based on handling the largest acceptable highway transport vehicle. Hauling construction costs have been analysed separately for each plant and are included in the screenings, grit, filter cake and incinerator ash handling construction costs.

Construction costs of incineration facilities are based on the use of multiple-hearth furnaces designed to produce stack effluent which will meet the current standards of the Air Pollution Board. They are also based on provision of completely new housing. Although the existing sludge drying building could be used to house the incinerators at the Southeast plant, it is assumed that renovation costs would equal the cost of new housing. The Envirotech Municipal Equipment Division computer program was used for estimating both sludge incineration and recalcining equipment costs.

Construction Contingencies

Contingent costs allow for uncertainties unavoidably associated with preliminary design. Such factors as foundation conditions, necessity for special construction methods, unexpected existing conflicts, and critical completion schedules are a few of the many items which may increase contract costs and for which allowances must be made in preliminary design estimates. For contingent items, an allownace of 30 percent is applied to all projects.

Engineering Costs

The cost of engineering services for major construction projects may include special investigations, predesign reports, surveys, foundation explorations, location of interfering utilities, detailed design, preparation of contract drawings and specifications, construction inspection, material testing, final inspection of the completed work and preparation of operation and maintenance

manuals. Depending on the size and type of the project, total engineering costs for improvements to San Francisco water pollution control plants may range from 12 to 20 percent of the contract cost. All work is expected to require large amounts of preliminary investigation to assure that proposed construction is compatible with existing conditions. The lower percentage given above applies to large projects and the higher percentage to small projects. Since the relative size of projects into which the proposed work may be divided cannot be anticipated at this time, engineering costs for the purpose of this report are based on 16 percent of the contract costs. When applied in sequence, construction contingencies and engineering amount to nearly 51 percent of the basic contract cost. An allowance of 50 percent is included in the preliminary cost estimates developed in this report for engineering and contingencies.

OPERATION COSTS

Operation costs are compared on the basis of labor; electric power; other utility costs; chemicals; maintenance, repair and supplies; screening and grit disposal; and other solids disposal for each alternative. Operation costs have been taken from the 1969-70 actual expenditure figures for each plant adjusted to 1971 costs. Adjustments have been made, where warranted by the nature of the improvements, to each operation cost item for each alternative. In some cases 1969-70 quantities are used with the actual expenditures to determine basic unit operating costs.

Labor

Labor costs are based on a unit cost developed by dividing the total wages paid in the 1969-70 fiscal year by the total number of employees directly involved at all plants. The total number of employees include the total personnel listed in Report 1, Phase I plus the 4 machinists, 2 gardeners and 1 instrumentation technician discussed in Chapter 2. Total wages include the cost of overtime, premium pay, holiday, extended work week, temporary salaries, and contractural services listed as 1969-70 actual expenditures in the City's 1971-72 budget recapitulation. The Sewage Treatment Plant General Superintendent, Associate Civil Engineer and Industrial Waste Inspector wages are not included because they are not considered to be directly involved in the operation of individual plant.

The unit cost figure developed has been adjusted by 13 percent to approximate the wage rate increases which were included in the 1970-71 budget. The unit cost per plant employee in 1971 was found by the above method to be approximately $16,000. This figure seems high, but since it includes allowances for overtime and premium pay and since few low salaried personnel are employed at the plants, it appears reasonable. Highly qualified personnel should be employed at the plants to insure that they are operated and maintained to obtain the best possible results and to protect the capital invested. This aspect becomes even more important as more sophisticated treatment processes and equipment are employed.

Electric Power

Electric power costs are based on a unit cost determined by dividing the 1969-70 power costs, as reported in the Bureau of Water Pollution Control annual report, by the total power used in all plants. The power used figures were obtained from the Bureau of Light, Heat and Power of the Hetch-Hetchy Water and Power Department. The unit cost figure developed was adjusted to $0.009 per kilowatt-hour to reflect 1971 prices.

Power is generated by the Hetch-Hetchy water system and is delivered to San Francisco and the plants by the Pacific Gas and Electric Company under a special power wheeling agreement. This agreement assures that the City's agencies pay a reduced rate, which, at the present time, amounts to 21 percent of the power bill. The present Hetch-Hetchy system generation capacity is approximately four times the present demands of City agencies. It is assumed, therefore, that all future power requirements for plant improvements will reflect this favorable arrangement.

Other Utilities

At the present time, the only other major utility cost at the treatment plants is for natural gas. City water is not metered and not billed

against the plant's account. Natural gas costs are based on a unit cost determined by dividing the total amount paid the Pacific Gas and Electric Company for gas in 1969-70 by the total gas used in all three plants. The figures were provided by the Bureau of Light, Heat and Power of the Hetch-Hetchy Water and Power Department. The unit cost so developed has been adjusted to reflect the unit costs for higher rates of use and is assumed to be $0.07 per Therm.

Chemicals

Chemical cost is a function of several factors including raw material availability and location, cost of manufacture, and cost of transportation. Because the regional and national demand for goagulant chemicals is expected to increase in the coming decades, the question of projecting future cost and availability is of critical importance to agencies which may anticipate large-scale coagulant use such as San francisco. Consequently, a brief survey of several of the major coagulant chemical suppliers was made to determine as nearly as possible the availability of coagulants both now and in the future. Other non-coagulant chemical costs were determined from current market prices and present costs at existing plants.

Ferric Chloride. Ferric chloride is manufactured locally by the Imperial West Chemical Co., Antioch, California, and the Great Western Chemical Co., Richmond, California (Table 5-1). Imperial West Chemical Co., appears to have obtained all the waste pickle liquor and other ferrous wastes available in the Bay Area. As a consequence, Great Western must either produce ferric chloride from waste iron or purchase pickle liquor from Imperial West.

Imperial West states that it has capacity to produce 24,000 tons per year with the ability to expand to 35,000 tons per year based on presently available by-product wastes. Since San Francisco could require up to 23,000 tons per year under some of the alternatives investigated, other uses of ferric chloride in northern California could cause the demand to exceed the supply. If this were to occur, ferric chloride would have to be imported from other areas which have greater reserves of ferrous waste. This, of course, would increase the cost of ferric chloride.

The future regional and national demand for ferric chloride is difficult if not impossible to predict. Ferric chloride costs were based on the 1971 quotation of Imperial West Chemical Co. of $77 per ton. This cost may increase by 50 to 100 percent in the future, depending on the scale of regional and national use.

Table 5-1

Coagulant Supply Sources and Costs

Chemical	Supplier	Volume, gallon	Total weight, tons	Percent active	Total weight active chemical, tons	Cost/ton active coagulant, dollars
Ferric chloride	Imperial West Chemical Co Antioch, Calif	3,600[b] 10,000[c]	21.7 60	40-46 40-46	9.3 27	77 81
Ferric chloride	Great Western Chemical Co Richmond, Calif	3,600[b]	21.7	40-46	9.3	110
Ferric chloride	Dow Chemical Midlands, Mich	10,000[c]	60	42-48	27	116
Lime (CaO)	U.S. Lime Apex, Nev	22,000[d]	90	92	83	28[a]
Lime (CaO)	U.S. Lime Richmond, Calif	5,000[e]	20	92	18.5	31[a]
Lime slurry ($Ca(OH)_2$)	Chemline Corp Berkeley, Calif	4,340[b]	-	-	8	17[a]

[a]As CaO.
[b]Tank truck delivery.
[c]RR tank truck car delivery.
[d]RR hopper car delivery.
[e]Hopper truck delivery.

Lime. Lime may be purchased as slurry (hydrated lime) or in dry form (calcium oxide). Purchase in slurry form is economical only when it is available as a by-product of acetylene manufacture. Chemline Corp. (Table 5-1) appears to be limited to a local production of 5000 tons per year on a sustained basis. While increased supply can be obtained from other Chemline plants across the country, the costs of transporting lime in slurry form would appear to make the purchase of lime in dry form more attractive for the large scale uses anticipated.

Lime as calcium oxide is made by quarrying limestone ($CaCO_3$) and calcining to obtain CaO. It can be purchased in bulk in either 90-ton lots by railroad hopper cars ($28 per ton CaO) or in 20-ton lots by truck ($31 per ton CaO).

Polymers. Organic polymers are aggressively marketed in the San Francisco Bay area by Hercules, Calgon, Diamond Shamrock, Nalco Chemical, American Cyanamid, and Dow Chemical Company. Prices in dry form range from $1.25 to $1.75 per pound.

Carbon dioxide. Carbon dioxide for recarbonation can be purchased in refrigerated liquid form for approximately $20-25 per ton and is available from Cardox, Inc., and two other suppliers.

Chlorine. Liquid chlorine is purchased in 30-ton tank cars at the North Point and Southeast plants and in ton cylinders at the Richmond-Sunset plant. The 1970-71 Water Pollution Control Division budget shows the cost for the tank car chlorine slightly under 3 cents per pound and the cost for ton cylinder chlorine slightly under 4.5 cents per pound.

Other Chemicals. Bulk salt is assumed to cost $24 per ton. Other chemicals for boiler water control and odor masking are expected to average about $1500 per year for the North Point and Southeast plants and $1000 per year for the Richmond-Sunset plant.

Maintenance, Repair and Supplies

Costs for maintenance, repair and supplies have been determined by totalizing the 1970-71 budget figures for these items for each plant and then increasing them in direct relationship to the increased investment for each alternative. It is believed that this will provide a reasonable basis for relating the effect of these items on the operation costs. It should be noted that budget cuts reduced the requests of the staff by 25 percent. For purposes of this report, the budget figures developed by the staff are used to determine the cost of each alternative.

Screenings and Grit Disposal

Although screening and grit disposal under the present budget is not shown as a separate item, it is necessary for comparison purposes to provide for this cost. This material must be either hauled to the land fill operations in Mountain View or incinerated. For the purposes of this report, disposal via hauling to land fill is assumed to cost $3.60 per ton. Disposal of screenings and grit by incineration is assumed to add no cost to the developed cost of incineration of other solids. This is considered reasonable because certain minimum handling operations by plant personnel are involved in both alternatives.

Other Solids Disposal

Cost for the disposal of filter cake or incinerator ash are based on hauling this material by special truck to the Mountain View land fill operations. Apparently, a new contract for this hauling is about to be negotiated and, therefore, the exact cost is presently unavailable. It has been assumed, however, that the new contract will continue to place a premium of 1-1/2 times unit cost for weekend, holiday and overtime (more than 8 hours per day) hauling. If this is the case, it is expected that the cost per ton for disposal of this material to Mountain view will average $3.60 to $5.40. For the purpose of this report, it is assumed to be $4.50 per ton. Recalcined lime hauling costs are assumed to be $0.50 per ton, excluding labor.

CHAPTER 6

ALTERNATIVE PLANS FOR SEWAGE TREATMENT AND DISPOSAL

Previous reports of this study have indicated the existence of at least four treatment alternatives which would provide either complete or partial attainment of the Regional Board goals for turbidity, discoloration, floatables, grease and settleable solids at the three water pollution control plants. Detail investigation discloses that there are actually at least five treatment alternatives at one plant and six at the other two plants which will produce levels of effluent and receiving water quality within these requirements. Two alternatives at the two plants with six alternatives and one at the plant with five alternatives will comply with all the objectives of the Board.

The performance projections for the treatment alternatives are based on existing plant performance, information obtained from operating facilities in other locales, and the pilot plant studies at North Point. Chemical dose rates are scaled from the North Point studies, with consideration to quality variations between the plants (see Appendix A for details on considerations dealing with lime sludge chemical yields, the potential for recalcination and solids handling balances at each plant). Continuing pilot and plant-scale studies may reduce the primary coagulant dose requirements and hence decrease chemical purchase and sludge processing costs.

NORTH POINT WATER POLLUTION CONTROL PLANT

The North Point plant with the greatest hydraulic loading and the least room for expansion present the biggest challenge to the development of alternative treatment schemes. Many alternative schemes were discussed and studied with the result that the following six were selected for economic analysis:

Alternative	Description
N1	Existing plant improvements (including North Point's share of solids handling improvements and additional thickeners at the Southeast plant) and the outfall extension.
N2	Existing plant and outfall improvements (including North Point's share of solids handling improvements and installation of additional thickeners and heat conditioning facilities at the Southeast plant) plus chemical treatment with low dose ferric chloride (15-45 mg/l), polymer (0.25 mg/l) for 12 hours per day and salt water (1200-1500 mg/l NaCl). Ferric, polymer, and salt water addition will be halted during periods of PWWF.
N3A	Existing plant and outfall improvements (including North Point's share of solids handling improvements and installation of additional thickeners and filters at the Southeast plant) plus chemical treatment with low dose lime (150-175 mg/l $Ca(OH)^2$, as slaked lime) and recarbonation.
N3B	Existing plant and outfall improvements (including installation of thickeners, filters, and incinerators at the Southeast plant) plus chemical treatment with low dose lime (150-175 mg/l) and recarbonation.
N4A	Existing plant and outfall improvements (including installation of thickeners and incinerators at the Southeast plant) plus chemical treatment with high dose lime (300-350 mg/l) and recarbonation.

N4B Existing plant and outfall improvements (including North Point's share of solids handling improvements and installation of additional thickeners and heat conditioning at the Southeast plant) plus chemical treatment with high dose ferric chloride (100-150 mg/l), polymer (0.50 mg/1), and salt water (1200-1500 mg/l NaCl) with filtration and effluent pumping.

All alternatives were studied on the basis of ADWF of 71 mgd, PWWF of 200 mgd and total suspended solids at ADWF of 194 mg/l.

Alternative N1

The most economical treatment process for the North Point plant is to retain and improve the existing plant. Chapter 3 of Report 2, Phase I, listed eight specific modifications to improve the existing plant's efficiency and reliability. We believe the evaluation of present plant operations and processes in Chapter 2 of this report confirms the Report 2 conclusions and indicates that some of the originally listed modifications require expansion. Thickening, digestion and filtering facilities for North Point sludge at the Southeast plant also require modifications to assure full attainment of treatment efficiency. These modifications include new thickening facilities, renovation of additional digesters, vacuum filter improvements and new digester supernatant and filter filtrate treatment facilities. One of the new, compact means of providing treatment for these high B. O. D. supernatant and filtrate anaerobic wastes consists of electrochemical oxidation by means of passing the wastes through electrolytic cells and then into air flotation tanks from which the foam is returned to the solids disposal system and the treated liquid returned to the plant effluent. The electrochemical oxidation eliminates odor, increases liquid wastes settleability and, when combined with separate foam removal, reduces the C. O. D. about 50 percent.

Reductions Expected. Once all of the proposed existing plant and outfall improvements are complete, it is expected that the following objectives can be attained at the North Point plant:

Alternative N1

Parameter	Objectives
Turbidity and color	Less than 30 percent reduction in receiving water clarity.
Floatables	Approximately 20 mg/sq meter floatables in the receiving water.
Grease	Greater than 30 mg/l grease in plant effluent.
Settleable matter	Less than 1.0 mg/l/hr in effluent samples at all times. An arithmetic average of less than 0.5 ml/l/hr in any six or more samples collected on any day. Doubtful that 80 percent of all individual samples collected during maximum daily flow over any 30 day period will be at or below 0.4 ml/l/hr.

Description of Construction. Existing plant improvements include the following additions and modifications:

1. Provisions for safe and prompt influent gate operation with package hydraulic power units for both the bypass and throttling sluice gates. Package units will each include a 1000 psi hydraulic cylinder gate operator, two small high pressure hydraulic pumps, an adequate reservoir, suitable emergency operation accumulators, hydraulic modulating controls, hydraulic piping and fittings and suitable housing. Use of individually packaged power units will minimize high pressure hydraulic piping and maximize reliability. Local and remote manual and remote automatic controls and gate position monitoring instrumentation will be included and tied into the centralized control system.

2. Installation of new heavy duty front-clean back-return automatic bar screens to replace the four existing units. Each screen will be provided with adequate up and downstream agitation air, a discharge hopper with automatic flap gates, a heavy duty dry grinder

and a 15 cubic foot pneumatic ejector. Each pneumatic ejector will be connected via special Ni-Hard piping systems to the existing grit storage bins. Two piping systems will be provided. The entire system will be designed to keep the screenings covered at all times.

Automatic controls will start the screens and grinders on high differential level between the down and upstream sides of any screen, maintain screen operation for as long as found necessary and assure proper rake position upon shutdown. Grinders will continue to operate for several minutes after screen shutdown. Pneumatic ejector loading will be monitored, and when loading is complete, the discharge hopper automatic flap gates will close, the grinder will shut down and the ejector will discharge its load into the grit storage bins. Ejector operation will be interlocked so that only one at a time will use the two common discharge pipes. It is expected that each pneumatic ejector will require about 30 to 40 seconds to empty. Controls and instrumentation will be tied into the centralized control system.

Compressed air supply for the pneumatic ejectors will be provided by a new system designed to supply air to both the screenings and grit handling system.

3. Installation of a new grit handling system. The system will consist of a heavy duty, reversible belt conveyor system which collects the discharge of each of the grit chamber screw conveyor and conveys it to either one of two pneumatic ejectors located in the existing grit sumps on either side of the grit chambers. Each pneumatic ejector will be provided with its own special Ni-Hard piping system to the grit storage bins. The entire system will be designed to keep the grit dry and covered at all times.

Automatic controls will monitor pneumatic ejector loading, and when the ejector is full, the belt conveyor will reverse and the ejector will discharge its load to the grit storage bins. Both screenings and grit systems will be provided with totalizers to maintain an accurate count on the quantity of material handled. Instrumentation and controls will be tied into the centralized control system.

4. Modification of the pretreatment building including grit storage bin and ventilation system revisions and modernization of power and controls. Grit storage bin revisions will include enlargement and enclosure of the bins and installation of level instrumentation to monitor storage availability. Ventilation system will include installation of positive supply and exhaust ventilation systems for all areas and odor removal equipment on exhausts from around bar screen, grit chambers and enclosed storage bins. Power and controls will be updated to provide sparkless apparatus in those areas exposed to open sewage surfaces or ventilation from such areas, automatic centralized control for the screening-grit isolating gates, and relocation of screenings power control center to provide atmospheric isolation and to eliminate any danger from flooding.

5. Revision of the raw sewage pump sumps and installation of variable speed pumping units complete with magnetic meters for pump discharge flow measurement and instrumentation and controls designed to maintain the most efficient upstream level in the grit chambers and screen channels and to minimize static pumping lift. Raw sewage pump sump revisions will eliminate all quiescent areas by utilizing smaller channels and air agitation. Each pump suction will be provided with an isolating gate. Variable speed pumping units will provide sufficient capacity to handle flows up to 200 mgd with one unit out of service. Pump sump revisions will assure the availability of all pumps at all times and will include individual pump suction drainage connections to a dewatering pump.

Magnetic meters will monitor plant flows and provide feed back signals for the pump speed control system. Sum of flows through meters will be used to control the pre- and postchlorination systems. Instrumentation and controls will assure that the plant handles as much of the combined sewage flow as possible during wet weather periods and will automatically control the throttling gate to limit flows when plant capacity is reached. Centralized manual controls will be provided to maintain the most efficient number of bar screens, grit chambers and raw sewage pumps in operation.

6. Remodeling of pump discharge structure to provide for the installation of isolating gates, the revision of the building ventilation system to limit odor production, and modernization of electrical apparatus. Ventilation

revisions will include covering of turbulent channels as required and treatment of ventilation exhaust from covered channel area. Electrical apparatus updating will include providing sparkless equipment within areas exposed to sewage surfaces.

7. Installation of new sparger air diffusers in preaeration portion of sedimentation tanks and lightweight, corrosion-proof covering over turbulent areas. Ventilation system revisions will include treatment of ventilation exhaust from covered channel area.

8. Modification of the sedimentation tanks to include more efficient scum and sludge collection, submerged effluent launders, improved ventilation, and modernization of power and controls. Scum collection revisions will include compressed air skimming and automatic scum removal. Sludge collection revisions will include new sludge cross collector channels and equipment located about 100 feet from the influent end of the preaeration-sedimentation tank and new longitudinal collector equipment designed to bring the sludge to the new cross collector channel. Submerged effluent launders will be fabricated of fiberglass and provided with orifices designed to operate in conjunction with new plant effluent control valves. Launder orifices will assure uniform distribution of sewage flow regardless of the number of tanks in service. Ventilation improvements will include construction of supply and exhaust plenums in high ceiling bays of each sedimentation structure and the installation of positive supply and exhaust ventilation systems within each structure. Power and controls will be updated to provide sparkless apparatus in those areas exposed to open sewage surfaces or ventilation from such areas, automatic centralized control of the scum and sludge collection equipment, and atmospheric isolation of the sedimentation area power control center.

9. Modification of chlorination facilities including additional chlorination capacity for postchlorination and raw sludge chlorination, new chlorine handling pipelines, and revisions to pre and postchlorination diffusers and control instrumentation. Chlorination capacity additions will consist of two additional 8000 lb/day evaporator-chlorinator combinations with chlorine vacuum piping designed to allow one of the new combinations to stand-by for either of the two existing postchlorination combinations. The existing prechlorination and new raw sludge combinations will be piped to stand-by for each other. Chlorine handling pipelines will be changed to handle chlorine gas under vacuum with pre-, post, and raw sludge injectors located in the field at the point of application. Pre and postchlorination diffusers will be relocated and redesigned to maintain efficient application and mixing with a minimum of gaseous release. Post chlorination will take place immediately upstream from the effluent control valves. Prechlorination will take place immediately upstream from the influent throttling sluice gate. Raw sludge chlorination will take place at the point where the dense sludge is diluted for transportation to the Southeast plant. Instrumentation signals and controls will be tied into the centralized control system.

10. Revision of the existing outfall system including installation of effluent control valves and construction of an outfall extension. effluent control valves will consist of two hydraulically operated throttling butterfly valves located just downstream from the sedimentation collection channel, complete with individual packaged hydraulic power units and instrumentation and controls capable of maintaining the sedimentation tank water surfaces within plus or minus 1/2-inch of optimum level regardless of flow or tide conditions. Gate hydraulic systems will be similar to influent gate units. Controls will automatically throttle the plant influent flow whenever flow and tide conditions exceed the hydraulic throttling capabilities of the effluent control valves. Valve position instrumentation and controls will be connected to the centralized control system.

Outfall extension will consist of approximately 1800 to 2000 feet of onshore pipeline and 4800 feet of submarine pipeline. The submarine pipeline will include 1850 feet of diffuser section located about 70 feet below U. S. Coast and Geodetic Survey mean lower water tidal datum and about halfway between the treatment plant and Alcatraz Island.

11. Modification of existing sludge and scum handling and disposal facilities by construction of a new solids handling gallery beneath the new sedimentation cross-collector channel. The gallery will house cross-

collector drive equipment, scum and sludge pumps, and related instrumentation and controls. Sedimentation cross-collectors will be of the screw type designed for variable speed operation with thickening ability. Scum and sludge pumps will be of the progressive cavity, positive displacement type with variable speed drives and will be piped directly to the Southeast force mains. Instrumentation and controls will include timers for sludge and scum collector control, sludge blanket detectors for raw sludge pump control, and liquid level transmitters for scum pump control. All instrumentation signals and controls will be tied into the centralized control system.

12. Enlargement of the existing sludge disposal capabilities by the construction of a second force main between the North Point plant and the Southeast plant. The new force main will be sized and used to provide 100 percent stand-by for the existing pipeline.

13. Installation of a new centralized power, control and communication systems with main graphic and control panels to be located in the administration building. Centralized power and control will include provisions to monitor and control all critical process operations and automatic devices and assure the safe shutdown of the facilities in case of a major malfunction of any critical operation. Centralized communication network will include paging, audio, intercommunication and sound powered communication between critical areas throughout the plant. Main plant power feeders will be designed to be supplied with electricity from two separate PG&E substation feeders. A 200 KW gas turbine stand-by power generator will be installed in the pretreatment building to provide emergency power for essential service. Non-interruptible battery power will assure instrumentation accuracy and switchgear and control availability at all times.

14. Installation of additional maintenance tools and equipment and special facilities for the maintenance of electrical and instrumental equipment.

15. Relocation of the No. 2 water pumps to the vicinity of the maintenance building storage tanks.

16. Installation of new effluent sampling and monitoring devices designed to provide chilled, proportional, composite samples and continuous records of effluent parameters such as D. O., turbidity, pH, temperature, specific conductance and others, as required. Data from all monitors will be transmitted to the centralized control center.

In addition to the North Point plant improvements, the following revisions and modifications should be made to the Southeast plant solids handling and disposal facilities to treat adequately the North Point solids:

17. Renovation of existing solids thickening facilities and construction of one additional unit so that total gravity thickening area equals at least 3750 square feet with adequate standby facilities. Thickening facilities will include automatic sludge and scum removal and pumping equipment, overflow and disposal piping, housing, ventilation and deodorization, and instrumentation control tied to the centralized control center in the filtration building.

18. Cleaning and renovation of digesters 1 through 3 to equal status with existing digesters 8 and 9. This work will include the installation of high energy gas mixing, piping revisions incorporating multiple transfer points and raw and digested sludge mixing, more efficient hot water heat exchangers, and greater capacity circulation pumps in more efficient locations. High energy gas mixing will involve the development of twice the velocity gradient presently found in digester 8 and 9. All electrical apparatus in the control building will be modified for operation in an hazardous area and positive ventilation with exhaust deodorization will be provided. Instrumentation and controls will be tied to the solids treatment control center in the filtration building. Work also includes installation of a hot water circulation system with new low pressure steam boilers. Boilers will be located in the elutriation area of the filtration building.

19. Renovation of the existing sludge filtering system including improvement of the sludge pumping system and expansion and alternation of the sludge conveyor systems. Work will include relocation of the filtering power and control equipment to an isolated

atmosphere and the development of this into a centralized power, control and communications center for the solids treatment operation of the Southeast plant. One-half of the cost of these modifications is chargeable to the North Point plant.

20. Renovation of the chemical handling and storage facilities to provide sufficient capacity and more precise control. One-half of the cost of these modifications is chargeable to the North Point plant.

21. Installation of digester supernatant and vacuum filter filtrate supplemental treatment facilities. Maximum capacity required for treating North Point sludge will be 9,000 gallons per hour. It is anticipated the system used will be an electrolytic wastewater treatment process which will disinfect, oxidize and improve the clarity of the supernatant and filtrate.

Description of Operation. As indicated in Chapter 2, existing plant improvements are not expected to result in major additional manpower requirements for the North Point plant or North Point share of Southeast manpower requirements. Some operating manpower will be switched to maintenance and the only additional staff will involve two specialized maintenance personnel for electrical and instrumentation repair functions. It is assumed the treatment of the present North Point wastes utilizes 55 personnel.

Although some additional power will be required for the influent and effluent gate control systems, the pneumatic screenings and grit handling, air skimming and ventilation and odor control, these should be offset by elimination of grit pumping and dual sludge pumping and more efficient raw sewage pumping. Power costs are expected to remain constant for the improved existing North Point plant, but will increase as the result of the addition of approximately 600 horsepower, over 1969-70 use, at the Southeast plant. Power used to treat sludge from North Point has been assumed to be 44 percent of the power used by the Southeast plant.

Other utilities are also expected to remain about the same as present although some additional costs may be involved in supplying fuel for boilers and standby generator. Natural gas use is expected to remain at the 1969-70 level, although some allowance has been made for digester upsets similar to those experienced in January and February of 1971. Gas used to treat sludge from North Point has been assumed to be 50 percent of the gas used by the Southeast plant.

Influent and effluent chlorine use is expected to remain about at the level presently being used, which is approximately 6,900 lbs/day. Chlorination of the raw sludge will increase the use of chlorine by about 500 to 600 lbs/day. It is expected that salt required for odor control facilities will amount to approximately 10,600 lbs/day. Ferric chloride and slaked lime use for filter cake production are expected to average about 1.2 and 7.2 tons per day, respectively.

Normally, it would be expected that maintenance and repair costs would decrease significantly with the construction of the revisions and modifications to the existing plant. The amount presently budgeted is below costs normally encountered, however, so a slight reduction is anticipated. A preventive maintenance program will result in some reallocation of maintenance and repair costs, but once these are established the allocations are expected to remain fairly constant over a long period of time.

Screenings, grit and sludge filter cake disposal costs will increase. Improvements to each of these systems are expected to increase the efficiency of removal with the result that significantly greater quantities of material will have to be handled. Screenings are expected to average about 4 cu ft per mil gal, grit 5 cu ft per mil gal and filter cake, prorated on a continuous basis, 116 tons per day. If screenings are 45 percent solids with a specific gravity of 1.0, disposal loadings are expected to average 8.0 tons per day. If grit is 65 percent solids with a specific gravity of 1.5, disposal loadings are expected to average 17.0 tons per day. It is anticipated alternative N1 will require half the existing filters at the Southeast plant to operate 10 hours per day, 6 days per week.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for improvements to the existing primary plant are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative N1

Sewage Treatment		Solids Treatment	
1.	$ 30,000	17.	820,000
2.	480,000	18.	1,725,000
3.	124,000	19.	305,000
4.	279,000	20.	50,000
5.	1,290,000	21.	354,000
6.	75,000	Subtotal	$ 3,254,000
7.	78,000		
8.	807,000	TOTAL	$19,136,000
9.	90,000		
10.	7,000,000		
11.	2,415,000		
12.	2,376,000		
13.	445,000		
14.	285,000		
15	45,000		
16.	63,000		
Subtotal	$15,882,000		

If all work must be completed by 1973, these costs should be increased by approximately 25 percent of $4,800,000.

Estimated Operation Costs. Estimated annual operating costs for the improved existing plant are based on 1971 prices and are as follows:

	Alternative N1
Labor	$ 923,000
Electric Power	121,000
Other utilities (gas, etc.)	14,000
Chemicals	205,000
Maintenance, repairs and supplies	55,000
Screenings and grit disposal	33,000
Other solids disposal	190,000
TOTAL	$1,541,000

Alternative N2

The least expensive alternative which will produce a higher level of effluent and receiving water quality than existing plant improvements involves combining the improvements with low dose ferric chloride chemical treatment. Low dose ferric chloride chemical treatment involves addition of 15-45 mg/l ferric chloride together with salt water and polymer to the raw sewage prior to pumping, preaeration and sedimentation. Because of chemical treatment, additional solids will be removed and solids handling and disposal facilities at the Southeast plant will have to be enlarged. It is anticipated that ferric chloride floc solids will not thicken as well as solids without chemicals and the gravity thickening rate has, therefore, been reduced to 15 lbs/sq ft/day and the percent solids content of the thickened sludge to 3.5. Both of these figures affect the solids handling system by increasing the thickening tank requirements and increasing the supernatant treatment requirements. To keep the filter cake volume approximately the same as that without chemical treatment, sludge heat conditioning is proposed. Heat conditioning of sludge, which was originally developed in England, has gained new favor as a means of sludge disposal in recent years. The process is used to condition raw or digested sludge in a reactor under moderate (200 psig) pressures and temperature (375°F). The process produces a sludge which is easily dewatered, biologically stable and suitable for either further processing by incineration or disposal as filter cake landfill. In addition, it has proven to be an efficient and low cost operation. The process, however, produces a liquid which is rich in nutrients and BOD. This decant must be added to the digester supernatant and filter filtrate volumes and treated by the electrolytic wastewater treatment process.

Reductions Expected. Upon completion of all the proposed existing plant and outfall improvements and the installation of low dose ferric chloride chemical treatment improve-

ments, it is expected that the following objectives can be attained at the North Point plant:

Alternative N2

Parameter	Objectives
Turbidity and color	Approximately 20 percent reduction in receiving water.
Floatables	Approximately 15 mg/square meter floatables in the receiving water.
Grease	Effluent concentration between 15 and 30 mg/l.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative N2, which involves existing plant improvements plus low dose ferric chloride chemical treatment, includes the following sewage treatment construction:

1. Construction of improvements to the existing North Point plant as listed under items 1-16, Alternative N1.

2. Installation of chemical storage and feeding facilities, including chemical metering pumps, fiberglass chemical storage tanks, and automatic controls. It is anticipated that the ferric chloride will be supplied, stored and fed in the liquid form.

3. Installation of salt water pumping facility designed to maintain 1200-1500 mg/l NaCl level in the plant influent. Permanent installation will consist of at least two variable speed pumps, each capable of pumping up to 10 mgd of bay salt water. Station will be located along bay front with discharge to the influent sewer. Automatic controls will be telemetered to plant.

4. Installation of storage and feeding facilities for applying 0.25 mg/l of polymer.

In addition to the North Point plant improvements, the following revisions and modifications should be made to solids handling and disposal facilities at the Southeast plant:

5. Renovation of existing solids thickening facilities plus installation of sufficient additional units so that the total gravity thickening area equals at least 6,700 sq ft plus adequate standby facilities. Thickening facilities will include automatic sludge and scum removal and pumping equipment, overflow and disposal piping, housings, ventilation and deodorization, and instrumentation control tied to the centralized control center in the filtration building.

6. Cleaning and renovating of digesters 1 through 4 to equal status with existing digesters 8 and 9. This work will include the installation of high energy gas mixing, piping revisions incorporating multiple transfer points and raw and digested sludge mixing, more efficient hot water heat exchangers, and greater capacity circulation pumps in more efficient locations. High energy gas mixing will involve the development of twice the velocity gradient presently found in digesters 7, 8 and 9. All electrical apparatus in the control building will be modified for operation in an hazardous area and positive ventilation with exhaust deodorization will be provided. Instrumentation and controls will be tied to the solids treatment control center in the filtration building. Work also includes installation of a hot water circulation system with new low pressure steam boilers. Boilers will be located in the elutriation area of the filtration building.

7. Renovation of the existing sludge filtering system as recommended for item 19, Alternative N1.

8. Installation of sludge heat conditioning facilities, including solids disintegration, heat exchangers, pumps, control valves, reactor vessels, treated sludge storage and decanting tanks, pressure ventilation and deodorization, and necessary controls. Facilities will have a capacity of 20,000 gallons per hour.

9. Installation of digester supernatant, heat conditioning decant, and vacuum filter filtrate electrolytic treatment facilities for 25,000 gallons per hour.

Description of Operation. The chemical treatment process proposed under alternative N2 will require relatively little additional manpower. It is anticipated the requirements of the additional chemical handling equipment will add no more than two additional personnel to those required for alternative N1. Both of these will be required to supplement the maintenance staff and most of their time will be chargeable against the solids handling facilities at the Southeast plant.

Alternative N2 will require more power than Alternative N1, because of pumping of approximately ten percent of the flow as salt water from the bay, additional solids pumping, additional digester gas mixers, heat conditioning treatment, and additional electrolytic treatment for supernatant, decant and filtrate wastes. It is estimated the extra power over 1969-70 use will involve the continuous running of approximately 1300 horsepower. No change is expected on the demands of the other utilities as long as the digesters stay reasonably healthy.

Influent and effluent chlorine use under alternative N2 will remain about the same as alternative N1. The only change might involve a slight increase in the quantity of chlorine used by the raw sludge. Odor control salt use is expected to remain constant. Approximately 8.9 tons per day of ferric chloride and 98 lbs/day of organic polymer will be required to provide the necessary chemical treatment. No chemicals will be required for filter cake production. Changes in maintenance and repair costs between alternatives N1 and N2 are expected to parallel the increased investment in equipment and facilities.

Screenings and grit disposal costs will remain unchanged between alternatives N1 and N2. It is anticipated that alternative N2 will require half the existing filters at the Southeast plant to be operated 8 hrs/day, 6 days/week. Filter cake production, when prorated on a continuous basis, is expected to average 87 tons per day. This lower filter cake volume reflects both the production of a dryer cake and the absence of filter assisting chemicals.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative N2 which provides for improved treatment efficiency through use of the existing plant improvements plus low dose ferric chloride chemical treatment are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative N2

Sewage Treatment		Solids Treatment	
1.	$15,882,000	5.	1,176,000
2.	155,000	6.	2,263,000
3.	135,000	7.	305,000
4.	24,000	8.	2,250,000
Subtotal	$16,196,000	9.	1,140,000
		Subtotal	$ 7,134,000
		TOTAL	$23,330,000

If all work must be completed by 1973, these costs should be increased by approximately 25 percent or $5,800,000.

Estimated Operation Costs. Estimated annual costs for existing plant improvement plus low dose ferric chloride chemical treatment are based on 1971 prices and are as follows:

	Alternative N2
Labor	$ 956,000
Electric power	161,000
Other utilities (gas, etc.)	14,000
Chemicals	433,000
Maintenance, repair and supplies	67,000
Screenings and grit disposal	33,000
Other solids disposal	143,000
TOTAL	$1,807,000

Alternative N3

For a higher level of effluent and receiving water quality than can be achieved under alternative N2, chemical treatment utilizing low dose lime combined with existing plant improvements is proposed. This process involves the addition of 150 to 175 mg/l of slaked lime to the raw sewage prior to preaeration and sedimentation, recycling of up to 25 percent of the ADWF through the preaeration flocculator, and recarbonation of the effluent prior to postchlorination. Additional flocculation tanks are required to assure reasonable sedimentation tank overflow

rates at PWWF. Solids produced will be increased substantially over alterantives N1 and N2 and major additions to sludge handling and disposal facilities at the Southeast plant will be required. Consequently, two alternatives were investigated for sludge handling and disposal. Alternative N3A involves thickening, digestion and filtering, while alternative N3B involves thickening, filtering and incinerating. Incineration includes recalcining for recovery of calcium oxide. Facilities for solids removal and disposal at the North Point plant are provided to allow for the recirculation of the preaeration underflow and for the fact that the solids concentration in the sludge pumped to the Southeast plant will increase to approximately 3.5 percent.

Reduction Expected. With the completion of all the proposed existing plant and outfall improvements and the installation of low dose lime chemical treatment improvements, it is expected that the following objectives can be attained at the North Point plant:

Alternative N3

Parameter	Objectives
Turbidity and color	Approximately 15 percent reduction in receiving water clarity.
Floatables	Less than 10 mg/square meter floatables in the receiving water.
Grease	Effluent concentration between 10 and 15 mg/l
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative N3 which involved low dose lime chemical treatment plus existing plant improvements, includes the following sewage treatment construction:

1. Construction of improvements to the existing North Point plant as listed under items 1-6 and 8-16, alternative N1.

2. Installation of chemical storage and feeding facilities, including storage hoppers, a conveying system, weighing hoppers, slaker feeders, and automatic controls. It is anticipated that two overhead hoppers will provide a combined storage capacity of 300 cu yds of calcium oxide and will be equipped with vibrators and distributors to insure full utilization of available volume. Calcium oxide will be transferred pneumatically from bulk delivery trucks or rail cars to the hoppers. From the hoppers, the calcium oxide will be conveyed to weighing hoppers located directly over the slakers. The slakers will incorporate gravimetric type feeders and will be located directly over the raw sewage collection channel in the pump discharge structure. Immediately after the slaked lime additions, the flow will be rapidly mixed mechanically to insure complete mixing of the lime with the raw sewage to be treated. All calcium oxide handling facilities will be designed for dust free operation with minimum maintenance and a peak feeding rate of 6 tons/hour.

3. Installation of new preaeration flocculation tanks at the influent end of the existing preaeration-sedimentation structures. Tanks will be constructed within the existing 32-foot equipment and utility area immediately adjacent to the existing preaeration tanks. Tanks will be designed for air flocculation and the existing preaeration tank longitudinal sludge collector will be extended to include the new tank. Access tunnel and influent distribution system will be relocated to the outside of the existing structure. Utility areas and equipment will be relocated to between the structures.

4. Installation of preaeration flocculator recycling facilities capable of recirculating up to 18 mgd of 5 percent underflow through the lime mixing and flocculation system. Six pumps will be variable speed units and system controls will be designed to maintain a one percent level of lime sludge slurry in the preaeration reactor.

5. Installation of recarbonation facilities including fiberglass carbon dioxide storage tanks and equipment and apparatus required to introduce gaseous CO_2 to the flow downstream and from the sedimentation effluent collection channel and upstream from the effluent control valves. The recarbonation system will be capable of lowering the effluent pH to approximately 7.9. Carbon dioxide system capacity will be at least 47.5 tons/day with 94 tons of chilled storage capacity. Carbon dioxide will be diffused into the flow by 20 stainless steel mixing diffusers designed to assure maximum assimilation. 3,100 sq ft of contact chamber area with 2.5 minutes retention at PWWF will be provided. Liquid CO_2 will be delivered by rail or truck tanker.

In addition to the North Point plant improvements, the following revisions and modifications should be made to solids handling and disposal facilities at the Southeast plant. Requirements for both alternatives previously discussed are given:

For alternative 3A which involves thickening, digestion and filtering:

6. Renovation of existing solids gravity thickening facilities and installation of sufficient additional units so that the total gravity thickening area equals at least 6,700 sq ft with adequate standby facilities. Thickening facilities will include automatic sludge and scum removal and pumping equipment, overflow and disposal piping, housings, ventilation, and instrumentation control tied to the solids treatment centralized control center in the filtration building of the Southeast plant.

7. Cleaning and renovation of digesters 1 through 4 as recommended for item 6, alternative N2.

8. Renovation of the existing sludge filtering system as recommended for item 19, alternative N1 plus installation ot two additional 11.5 x 16 ft vacuum filters with necessary upporting structure and equipment.

9. Installation of digester supernatant and vacuum filter filtrate electrolytic treatment facilities for 18,000 gallons per hour.

For alternative N3B which involves thickening, filtering, incineration, and recalcining:

10. Renovation of existing solids gravity thickeners and installation of additional units as recommended in item 6, alternative N3A except to provide 7,100 sq ft of surface area.

11. Renovation of existing sludge filtering system as recommended for item 19, alternative N1, plus installation of two additional 11.5 x 16 ft vacuum filters with necessary supporting structure and equipment.

12. Cleaning and renovation of digesters 1 and 2 for use as raw sludge holding tanks. Work will include the installation of high energy gas mixers, adequate piping, improved circulation and transfer pumping, and necessary controls.

13. Installation of two 140 dry tons/day, 22.25 ft diameter, 10 hearth incinerators with recalcining equipment and 40 cu yd of storage for recalcined lime. Incinerators will include necessary equipment to handle screenings and grit from the North Point plant, access platform, instrumentation and controls and gas stack scrubbers and afterburners, and will maintain a plumeless stack discharge complying with all present air pollution regulations. Ash storage and loading facilities and a special hopper type truck for hauling recalcined lime will also be included. The two incinerators will provide complete standby capacity. Instrumentation and controls will be tied to the solids treatment centralized control center in the filtration building at the Southeast plant.

14. Installation of vacuum filter filtrate electrolytic treatment facilities for 16,000 gallons per hour.

Description of Operation. The chemical treatment process proposed under alternative N3 will require more manpower than alternatives N1 and N2. It is anticipated the calcium oxide handling and mixing equipment and the recarbonation equipment at the North Point plant for both alternatives N3A and N3B will require the equivalent of one full-time maintenance operator in addition to the other personnel required for alternative N1. With continuous duty the maintenance operator position alone will entail addition of at least five new personnel. In addition, it is expected that alternative N3B will require at least five new personnel for the thickener, filter, incinerator and recalcining equipment operation at the Southeast plant. At least one truck driver will be required for transport of lime between the Southeast and North Point plants. No additional manpower is expected to be required at the Southeast plant for alternative N3A.

More power will be required for operation under alternative N3 than under alternative N1. Extra power use will result from the chemical handling facilities, underflow recycling and carbon dioxide diffusion at the North Point plant and from the additional solids thickening, filtering, and digester mixing or incineration facilities at the Southeast plant. If the underflow recycling averages 10 percent of the plant flow, it is estimated the extra power requirements over 1969-70 use will approximate 1300 horsepower on a continuous basis for alternative N3A and approximately 1250 horsepower for alternative N3B. Other utility costs are expected to remain about the same as for alternative N1, except for the use of 2160 Therms/day of natural gas by the recalcining incinerator of alternative N3B. Gas use could

increase under alternative N3A if the digesters fail to operate satisfactorily.

Influent and effluent chlorine use under alternative N3 will remain the same as alternative N1. No chlorine will be used for the raw sludge, because the high pH and lime content will do the same job of retarding bacterial activity. Salt requirements for odor control will drop to approxiamtely 6,000 lbs/day because control systems will no longer be required for the preaeration areas. It is estimated that alternative N3A will require approximately 40 tons/day of calcium oxide to provide the necessary chemical treatment. Use of recalcined lime plus ash from the Southeast plant will reduce the new calcium oxide requirements for alternative N3B to 15.5 tons/day. No chemicals will be required for filter cake production. Carbon dioxide use is expected to average 16.9 tons/day.

Changes in maintenance and repair costs between alternatives N1 and N3A or N3B are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives N1 and N3A. For alternative N3B, however, they will be reduced since these materials can be combined wiht the sludge for incineration at Southeast. Screenings and grit are expected to provide an average additional incineration load of approximately 25.8 tons/day of wet solids. Alternative N3A with half of the existing filters plus the 2 new filters operating 16 hrs/day, 6 days/week is expected to produce, when prorated on a continuous basis, an average of approximately 276 ton/day of sludge filter cake. Alternative N3B is expected to produce an average of approximately 47.5 tons/day of damp ash (20 percent moisture) to be hauled to landfill disposal and an average of approxiamtely 31.5 tons/day of reclacined lime and ash to be hauled to the North Point plant. It is anticipated that alternative N3B will require half the existing filters plus the 2 new filters to operate 20 hours per day 6 days per week.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative N3 which provides for improved treatment efficiency through use of existing plant improvements plus low dose lime chemical treatment are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative N3

Sewage Treatment

1.	$15,804,000
2.	480,000
3.	2,100,000
4.	75,000
5.	1,100,000
Subtotal	$19,559,000

Solids Treatment

Alternate N3A

6.	$ 1,176,000
7.	2,263,000
8.	1,685,000
9.	713,000
Subtotal	$ 5,837,000
TOTAL	$25,390,000

Alternate N3B

10.	$ 1,176,000
11.	1,685,000
12.	750,000
13.	5,850,000
14.	633,000
Subtotal	$10,094,000
TOTAL	$29,653,000

If all work must be completed by 1975, these costs should be increased by approximately 25 percent or $6,300,000 and $7,400,000 respectively.

Estimated Operation Costs. Estimated annual operating costs for existing plant improvements plus low dose lime chemical treatment are based on 1971 prices and are as follows:

Alternatives

	N3A	N3B
Labor	$1,005,000	$1,101,000
Electric power	161,000	157,000
Other utilities (gas, etc)	14,000	69,000
Chemicals	651,000	400,000
Maintenance, repair and supplies	74,000	85,000
Screenings and grit disposal	33,000	5,000
Other solids disposal	454,000	84,000
TOTAL	$2,392,000	$1,901,000

Alternative N4A

The lowest first cost alternative which will produce a level of effluent and receiving water quality meeting all of the most stringent requirements of the Regional Board at the North Point plant involved combining the existing plant improvements with high dose lime chemical treatment. High dose lime chemical treatment involves dosage of the raw sewage prior to preaeration and sedimentation with 300 to 350 mg/l of slaked lime, recycling of up to 25 percent of the ADWF through the preaeration flocculator, and recarbonation of the effluent prior to postchlorination. Additional flocculation tanks are required to assure reasonablr sedimentation tank overflow rates at PWWF. Solids prodiced will be increased substantially over other alternatives and major additions to sludge handling and disposal facilities at the Southeast plant will be required. The magnesium content of the North Point raw sewage is high enough to cause large quantities of soluble calcium to be lost in the effluent and the formation of large quantities of magnesium hydroxide precipitate. These effects reduce the calcium oxide fraction of the recalcined product as well as the total amount of CaO which can be recovered. For these reasons, it is not considered practical to provide for recalcining at the Southeast plant and hauling recalcined lime and ash from there to the North Point plant. Facilities for solids removal and disposal at the North Point plant will be designed to allow for the recirculation of the preaeration underflow and for the fact that the solids concentration in the pumped sludge to to the Southeast plant will increase to approximately 4.9 percent.

Reductions Expected. With the completion of all the proposed existing plant and outfall improvements and the installation of high dose lime chemical treatment it is expected that the following objectives can be attained at the North Point plant:

Alternative N4A

Parameter	Objectives
Turbidity and color	Less than 5 percent reduction in receiving water clarity.
Floatables	Less than 10 mg/sq meter floatables in the receiving water.
Grease	Less than 5 mg/l in plant effluent.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative N4A, which involves high dose lime chemical treatment plus existing plant improvements, includes the following sewage treatment construction:

1. Construction of improvements to the existing North Point plant as listed under items 1-6 and 8-16 alternative N1.
2. Installation of chemical storage and feeding facilities, including storage hoppers, a conveying system, weighing hoppers, slaker feeders, and automatic controls. It is anticipated taht three overhead hoppers will provide a combined storage capacity of 450 cu yds of calcium oxide. Calcium oxide will be transferred pneumatically from bulk delivery trucks or rail cars to hoppers. From the hoppers, the calcium oxide will be conveyed to weighing hoppers located directly over the slakers. The slakers will incorporate gravimetric type feeders and will be located directly over the raw sewage collection channel in the pump discharge structure. Immediately after slaked lime addition, the flow will be rapidly mixed mechanically to insure complete mixing of the lime with the raw sewage to be treated. All calcium oxide handling facilities will be designed for dust free operation with minimum maintenance and a peak feeding rate of 18.7 tons/hour.
3. Installation of new preaeration flocculation tanks as recommended in item 3, alternative N3.
4. Installation of preaeration flocculator recycling facilities as recommended in item 4, alternative N3.

5. Installation of recarbonation facilities including fiberglass carbon dioxide storage tanks and equipment and apparatus required to introduce the gaseous CO_2 to the flow downstream from the sedimentation effluent collection channel and upstream from the effluent control valves and postchlorination diffusers. The recarbonation system will be capable of lowering the effluent pH to 7.8, will have a capacity of at least 47.5 tons/day and a chilled storage capacity of 94 tons. Carbon dioxide will be diffused into the flow by 20 stainless steel mixing diffusers designed to assure maximum assimilation. 3,100 sq ft of contact chamber area with 2.5 minutes of retention at PWWF will be provided. Liquid Co_2 will be delivered by rail or truck tankers.

In addition to the North Point plant improvements, the following revisions and modifications should be made to solids handling and disposal facilities at the Southeast plant:

6. Renovation of existing solids gravity thickening facilities and installation of sufficient additional units so that the total gravity thickening area equals at least 10,000 sq ft with adequate standby facilities. Thickening facilities will include automatic sludge and scum removal and pumping equipment, overflow and disposal pumping, housings, ventilation, and instrumentation control tied to the solids treatment centralized control center in the filtration building of the Southeast plant.

7. Renovation of existing sludge filtering system as recommended for item 19, alternative N1, plus installation of two additional 11.5 x 16 ft vacuum filters with necessary additional supporting structure and equipment. It is expected half of the existing filters plus the new filters will be able to handle the plant load by operating approximately 20 hours per day, 6 days per week.

8. Cleaning and renovation of digesters 1 and 2 for raw sludge holding tanks as recommended for item 12, alternative N3B.

9. Installation of three 95 dry tons/day, 22.25 ft diameter, 9 hearth incinerators. Incinerators will include necessary equipment to handle screenings and grit from the North Point plant, access platforms, instrumentation and controls, and stack scrubbers and afterburners, and will maintain plumeless stack discharge complying will all present air pollution regulations. Ash storage and loading facilities are also included. Any two incinerators will be capable of handling dry weather loadings. Instrumentation and controls will be tied to the solids treatment centralized control center in the filtration building at the Southeast plant.

10. Installation of vacuum filter filtrate electrolytic treatment facilities for 23,000 gallons per hour.

Description of Operation. The chemical treatment process proposed under alternative N4A will require more manpower when compared with the alternatives providing lesser treatment. It is anticipated the calcium oxide handling and mixing equipment and the recarbonation equipment at the North Point plant will require the equivalent of two full-time maintenance operators in addition to the other personnel required for alternative N1. With continuous duty, these maintenance operator positions alone will entail the addition of at least 10 new personnel. In addition, it is expected that the increased sludge handling and disposal facilities at the Southeast plant will also require at least ten new personnel.

More power will be required for operation under alternative N4A than under alternative N1. Extra power use will result from the chemical handling facilites, underflow recycling and carbon dioxide diffusion at the North Point plant and from the additional solids thickening, filtering and incineration facilities at the Southeast plant. If the underflow recycling averages 10 percent of the plant flow, it is estimated that the extra power over 1969-70 use will involve the continuous running of approximately 1600 horsepower. Other utility costs are expected to remain about the same as for alternative N1, except for the use of 3500 Therms/day of natural gas by the incinerator.

Influent chlorine use under alternative N4A will remain the same as alternative N1 at 3 mg/l, or 1760 lbs/day. No chlorine will be used for the raw sludge, because the high pH and lime content will do the same job of retarding bacterial activity. Effluent chlorine requirements are expected to be appreciably less than for alternatives providing a lesser degree of treatment. Chlorine use for disinfection is expected to be reduced to about 6 mg/l, or about 3520 lbs/day. Salt requirements for odor control will drop to approximately 6000

lbs/day because control systems will no longer be required for the preaeration areas. It is estimated that approximately 79.5 tons/day of calcium oxide will be required to provide the necessary chemical treatment. No chemicals will be required for filter cake production. Carbon dioxide use is expected to average 16.9 tons/day.

Changes in maintenance and repair costs between alternatives N1 and N4A are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs are expected to be substantially reduced by providing sufficient incineration capacity to include them with the North Point sludge. Screenings and grit are expected to provide an average additional incineration load of approximately 25.8 tons/day wet solids. The incinerator system is expected to produce an average of approximately 179 tons/day of damp ash (20 percent moisture) to be hauled to landfill disposal.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative N4A which provides for existing plant improvements plus high dose lime chemical treatment are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative N4A

Sewage Treatment		Solids Treatment	
1.	$15,804,000	6.	1,710,000
2.	681,000	7.	1,685,000
3.	2,100,000	8.	750,000
4.	75,000	9.	8,745,000
5.	1,100,000	10.	1,065,000
Subtotal	$19,760,000	Subtotal	$13,953,000
		TOTAL	$33,715,000

If all work must be completed by 1975, these costs should be increased by approximately 25 percent or $8,400,000.

Estimated Operation Costs. Estimated annual operating costs for existing plant improvements plus high dose lime chemical treatment are based on 1971 prices and are as follows:

	Alternative N4A
Labor	$1,248,000
Electric power	180,000
Other utilities	104,000
Chemicals	1,034,000
Maintenance, repair and supplies	96,000
Screening and grit disposal	5,000
Other solids disposal	295,000
TOTAL	$2,962,000

Alternative N4B

The lowest operation cost alternative which will produce a level of effluent and receiving water quality meeting all of the most stringent requirements of the Regional Board at the North Point plant involves the combining of the existing plant improvements with high dose ferric chloride chemical treatment followed by dual media filtration with effluent pumping. High dose ferric chloride chemical treatment involves the dosage of the raw sewage prior to pumping, preaeration and sedimentation with 100-150 mg/l of ferric chloride, salt water and polymer.

Because of chemical treatment, additional solids will be removed and solids handling and disposal facilities at the Southeast plant will have to be enlarged. To assure proper solids thickening with the lighter ferric chloride floc, flotation type thickeners loaded at 20 lbs/sq ft/day are recommended and the percent solids content of the thickened sludge held to 4. Both of these figures materially affect the solids handling system by increasing thickening system costs and increasing the supernatant treatment requirements.

To maintain relatively low filtering costs and assure the use of the existing filtering system without expensive enlargements, sludge heat conditioning similar to that described for alternative N2 is proposed for this alternative. It is expected that the heat conditioned digested solids will filter without chemical addition at the rate of 10 lbs/sq ft/day. The digester supernatant, heat condition-

ing decant, and filter filtrate will be treated by the electrolytic wastewater treatment process.

Reductions Expected. With the completion of all the proposed existing plant and outfall improvements and the installation of high dose ferric chloride chemical treatment followed by filtration and effluent pumping, it is expected that the following objectives can be attained at the North Point plant.

Alternative N4B

Parameter	Objective
Turbidity and color	Less than 5 percent reduction in receiving water clarity.
Floatables	Less than 10 mg/sq meter floatables in the receiving water.
Grease	Less than 5 mg/l in plant effluent.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative N4B, which involves high dose ferric chloride treatment with filtration and effluent pumping plus existing plant improvements, includes the following sewage treatment construction:

1. Construction of improvements to the existing North Point plant as listed under items 1-6 and 8, 11-16, alternative N1.

2. Installation of chemical storage and feed facilities, including chemical metering pumps, three fiberglass chemical storage tanks and automatic controls. It is anticipated that the ferric chloride will be supplied, stored and fed in the liquid form. The chemical metering pumps will have a peak capacity of 125 tons/day with adequate standby and the storage tanks will have a total capacity for about 216 tons.

3. Installation of salt water pumping facilities as recommended in item 3, alternative N2.

4. Installation of storage and feeding facilities for applying 0.50 mg/l of polymer 24 hours/day. Feeding facilities will have a peak capacity of 850 lbs/day with adequate standby and storage facilities will have the capacity for about 2000 pounds.

5. Installation of mechanical flocculating equipment in the existing preaeration tanks. Flocculators will be installed to operate in the reverse direction 10 minutes of every hour. They will be installed above the existing collection equipment which will remain in place and in operation. Flocculator impellers will be designed to de-rag when operated in reverse.

6. Installation of nine bifurcated dual-media filters each of which will have 3000 sq ft of surface area. The entire filtration system will be installed immediately downstream from the sedimentation hydraulic level control valves and will include air-water backwash facilities and automatic head loss and backwash controls. Backwash water will be provided by two pumps, each capable of providing one-half of a filter with 43 mgd of filter effluent. It is anticipated that backwashing will require from 7 to 10 percent of the filter effluent. Backwashings will be discharged to the raw sewage flow immediately downstream from the grit collection chambers. Any 8 filters will be capable of handling the peak wet weather flow.

7. Installation of an effluent pumping station with sufficent capacity to pump 200 mgd from the filter effluent collection well through the submarine outfall to San Francisco Bay against the highest high tide. Six pumps will be provided with any four capable of handling the peak flow. Pumps will have variable speed electric drives and automatic controls.

8. Modification of chlorination facilities as recommended under item 9, alternative N1, except for the relocation of postchlorination to immediately upstream from the effluent pumps.

9. Revision of existing outfall system as recommended under item 10, alternative N1, except for the operation of the effluent control valves. Valves will maintain optimum sedimentation tank water level regardless of flow or filter operation.

In addition to the North Point plant improvements, the following revisions and modifications should be made to solids handling and disposal facilities at the Southeast plant:

Renovation of existing gravity thickening facilities to provide flotation thickening and installation of sufficient additional units so that the system provides approxiamtely 7500 sq ft of flotation thickening tanks with adequate standby units. Each flotation thickening tank will be provided with top scum and bottom

sludge collection and removal equipment, effluent and compressed air dissolving equipment, and automatic controls. Tanks will be housed and provided with positive ventilation and odor control equipment. Thickener overflow will be pumped to the raw sewage discharge structure. Automatic controls and instrumentation will be tied to the solids treatment centralized control center in the filtration building of the Southeast plant.

11. Cleaning and renovation of digesters 1 through 5 to equal status with existing digesters 8 and 9. This includes installation of high energy gas mixing, piping revisions incorporating multiple transfer points and raw and digested sludge mixing, more efficient hot water heat exchangers, and greater capacity circulation pumps in more efficient locations. High energy gas mixing will involve the development of twice the velocity gradient presently found in digesters 8 and 9. All electrical apparatus in the digester control building will be modified for operation in an hazardous area and positive ventilation with exhaust deodorization will be provided. Instrumentation and controls will be tied to the solids treatment control center in the filtration building of the Southeast plant. Work also includes installation of a hot water circulation system with new low pressure steam boilers. Boilers will be located in the elutriation area of the filtration building.

12. Installation of digested sludge heat conditioning facilities, including solids disintegration, heat exchangers, pumps, control valves, reactor vessels, treated sludge storage and decanting tanks, and necessary controls. Facilities will have a capacity of 27,000 gallons per hour.

13. Renovation of existing sludge filtering system as recommended for item 19, alternative N1.

14. Installation of digester supernatant, heat conditioning decant, and vacuum filter filtrate electrolytic treatment facilities for 29,000 gallons per hour.

Description of Operation. The chemical treatment process with filtration and effluent pumping proposed under alternative N4B will require more manpower when compared with alternatives providing lesser treatment. It is anticipated the ferric chloride handling and flocculating equipment, the filters and equipment, and the effluent pumping equipment at the North Point plant will require the equivalent of two full-time maintenance operators in addition to the other personnel required for alternative N1. With continuous duty, these positions alone will entail the addition of at least 10 new personnel. In addition, it is expected that the revised, renovated and enlarged solids handling facilities at the Southeast plant will require three additional personnel.

More power will be required for operation under alternative N4B than under alternative N1. Extra power use will result from the mechanical flocculation, filter backwash and effluent pumping at the North Point plant, and from flotation thickening, additional digester operation, heat conditioning, filtering and electrolytic wastewater treatment at the Southeast plant. It is estimated that the extra power over 1969-70 use will involve the continuous operation of approximately 2800 horsepower. Other utility costs are expected to remain about the same as for alternative N1.

Influent and effluent chlorine use under alternative N4B will remain the same as alternative N4A. The only additional chlorine use will involve an increase in the quantity of chlorine used by the raw sludge. It is expected this chlorine use could amount to approximately 1000-1200 lbs/day. Salt requirements for odor control will be approximately 12,000 lbs/day. It is expected that approximately 25 tons/day of ferric chloride and 295 lbs/day of organic polymer will be required to provide the necessary chemical treatment. No chemicals will be required for filter cake production.

Changes in maintenance and repair costs between alternatives N1 and N4B are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives N1 and N4B. It is anticipated that alternative N4B will require half the existing filters at the Southeast plant to be operated 14 hours/day, 6 days/week. Filter cake production, when prorated on a continuous basis, is expected to average 150 tons/day.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative N4B which provides for the existing plant improvements plus high dose ferric chloride chemical treatment with filtration and effluent pumping, are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative N4B

Sewage Treatment		Solids Treatment	
1.	$ 8,651,000	10.	$ 1,719,000
2.	375,000	11.	2,950,000
3.	135,000	12.	3,075,000
4.	30,000	13.	305,000
5.	270,000	14.	1,220,000
6.	13,260,000	Subtotal	$ 9,289,000
7.	1,800,000	TOTAL	$40,900,000
8.	90,000		
9.	7,000,000		
Subtotal	$31,611,000		

The costs given above do not include any allowance for purchase of land required for effluent filters and pumping station. If all work must be completed by 1975, these costs should be increased by approxiamtely 25 percent or $10,200,000.

Estimated Operation Costs. Estimated annual operating costs for existing plant improvements plus high dose ferric chloride chemical treatment with filtration and effluent pumping are based on 1971 prices and are as follows:

	Alternative N4B
Labor	$1,134,000
Electric power	258,000
Other utilities (gas, etc)	14,000
Chemicals	1,066,000
Maintenance, repair and supplies	118,000
Screening and grit disposal	33,000
Other solids disposal	246,000
TOTAL	$2,869,000

Summary

Table 6-1 presents the predicted plant performance for each of the alternatives proposed for the North Point plant. Table 6-2 summarizes estimated construction and operating costs of the alternatives.

Table 6-1

Predicted Performance of Alternative Treatment Processes, North Point Water Pollution Control Plant

Alternative	Percent reduction in receiving water clarity	Floatable concentration in receiving water mg/sq meter	Grease concentration in effluent, mg/l	Settleable matter in effluent ml/l		
				a	b	c
N1	< 30[d]	20[d]	> 30	< 1.0[e]	< 0.5[e]	> 0.4
N2	20[d]	15[d]	15-30[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
N3	15[d]	< 10[e]	10-15[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
N4A	< 5[e]	< 10[e]	< 5[e]	< 1.0[e]	< 0.5[e]	< 0.4[e]
N4B	< 5[e]	< 10[e]	< 5[e]	< 1.0[e]	< 0.5[e]	< 0.4[e]

[a] Maximum in any one sample.

[b] Arithmetic average of any six or more samples collected on any day.

[c] 80 percent of all individual samples collected during maximum daily flow over any 30-day period.

[d] Meets minimum stipulated objective.

[e] Meets maximum stipulated objective.

Table 6-2

Estimated Construction and Operating Costs of Alternative Treatment Processes, North Point Water Pollution Control Plant

Alternative	Estimated construction cost, dollars[a]	Estimated annual operating cost, dollars
N1	19,136,000	1,541,000
N2	23,330,000	1,807,000
N3A	25,390,000	2,392,000
N3B	29,653,000	1,901,000
N4A	33,715,000	2,962,000
N4B	40,900,000	2,869,000

[a] No land costs included. See appendix E1 for additional area required for each alternative.

RICHMOND-SUNSET WATER POLLUTION CONTROL PLANT

The Richmond-Sunset plant is the only one of the three San Francisco plants which treats both sewage and solids from only its tributary area and for which alternative processes need only be concerned with a single plant. Additionally, reasonable land area within Golden Gate Park appears to be available for expansion and selection of alternative processes was not restricted by this limitation. The following five alternatives were selected for economic analysis:

Alternative	Description
R1	Existing plant improvements with effluent pumping and an outfall extension.
R2	Existing plant improvements, effluent pumping and outfall extension plus dissolved air flotation treatment with a 33-50 percent recycle rate, a maximum surface loading rate of 2 gpm/sq ft not including recycle flow, and an air pressure of 60 psi.
R3	Existing plant improvements, effluent pumping and outfall extension plus chemical treatment with low dose ferric chlroide (15-45 mg/l) polymer (0.25 mg/l) for 12 hours per day and salt water (1200-1500 mg/l NaCl). Ferric chloride, polymer, salt water addition and sewage flocculation would be halted during periods of PWWF.
R4A	Existing plant improvements, effluent pumping and outfall extension plus biological treatment utilizing the activated sludge process with secondary sedimentation.
R4B	Existing plant improvements, effluent pumping and outfall extension plus chemical treatment with high dose lime (240-280 mg/l), recarbonation and solids incineration with recalcining.

All alternatives were studied on the basis of ADWF of 28 mgd, PWWF of 70 mgd and total suspended solids at ADWF of 190 mg/l. The latter figure for total suspended solids was arrived at by increasing the plant staff's determination of 155 mg/l by the same percentage of increase found at the North Point and Southeast plants during the course of this study. Further study of the results presented in Report 1, Phase I, have convinced us that the total suspended solids study results for the Richmond-Sunset plant are unreasonably high. Although no mathematical errors have been found, the obvious impossibility of suspended solids being 100 percent volatile and the better processes mass balance achieved with the adjusted influent and effluent figures leads to the conclusion that the study results given for Richmond-Sunset influent and effluent do not reflect the existing conditions.

Alternative R1

The most economical treatment process for the Richmond-Sunset plant is to retain and improve the existing plant and provide it with effluent pumping and an outfall extension. Chapter 3 of Report 2, Phase I, listed seven specific modifications to improve the existing plant's efficiency and operation. As indicated for the North Point plant, we believe the evaluation of present plant operations and processes in Chapter 2 of this report confirms the Report 2 conclusions and indicates that some of the originally listed modifications require expansion.

Reductions Expected. Once all of the proposed existing plant improvements, effluent pumping and outfall extension are complete, it is expected that the following objectives can be attained at the Richmond-Sunset plant:

Alternative R1

Parameter	Objectives
Turbidity and color	Less than 30 percent reduction in receiving water clarity.
Floatables	Approximately 20 mg/sq meter floatables in the receiving water.
Grease	Greater than 30 mg/l grease in plant effluent.
Settleable matter	Less than 2.0 ml/l/hr in effluent samples at all times. An arithmetic average of less than 0.5 mg/l/hr in any six or more samples collected on any day. Doubtful that 80 percent of all individual samples collected during maximum daily flow over any 30-day period will be at or below 0.4 ml/l/hr.

Description of Construction. Existing plant improvements, effluent pumping and outfall extension includes the following sewage treatment revisions and modifications construction:

1. Installation of pump discharge flap gate and lightweight manual isolating slide gate at the end of each Sunset pumping station pump discharge force main. Construction will involve structural revisions to the force main receiving structure and will allow for the removal of the individual pump check valves in the Sunset pumping station with a subsequent increase in capacity and reliability.

2. Modification of influent piping for approximately 40 ft upstream of each bar screen. The 36-inch pipes will be removed and replaced with open channels with gradually increasing width designed to dissipate the excessive bar screen approach velocities. Agitation will be provided, if required, to eliminate solids settling at minimum flows. Air agitated channels will be provided with lightweight removable covers and exhausted to separate deodorizing equipment.

3. Revision of the influent hydraulic control system (1) to maintain constant level in the grit chambers, (2) to provide equal flow distribution between all chambers in service, (3) to maintain velocities through screens at optimum for efficient screenings removal, and (4) to assure utilization of the complete hydraulic capacity of the plant. Construction will include the revision to the height of the raw sewage overflow weir, modification of the screened sewage bypass butterfly valve, elimination of grit chamber inlet butterfly valves and overflow weirs, installation of submerged orifice outlets in each grit chamber, and installation of two influent control valves.

The height of the raw sewage overflow weir will be raised sufficiently to assure it does not operate except when the plant's hydraulic capacity is reached or upon failure of all screens. Automatic controls will maintain a maximum differential head loss across the screens of six inches. Local and remote manual and remote automatic controls and screen differential head loss monitoring instrumentation will be included and tied into the centralized control system. The downstream isolating valve in the screen channel will be modified to assure free surface flow to the grit chamber distribution channel. Where required, screen and distribution channels will be air agitated to eliminate solids settling of minimum flows. Air agitated channels will be covered and exhausted to separate deodorizing equipment.

The screened sewage bypass butterfly valve will be provided with a package hydraulic power unit designed to modulate whenever

the influent control valves can no longer maintain a constant level in the grit chambers. The package unit will include a 1000 psi hydraulic cylinder gate operator, two small high pressure hydraulic pumps, an adequate reservoir, suitable emergency operation accumulators, hydraulic modulating controls, hydraulic piping and fittings and suitable housing. Use of individual packaged power units minimizes high pressure hydraulic piping and maximizes reliability. Local and remote manual and remote automatic controls and gate position monitoring instrumentation will be included and tied into the centralized control system.

Each grit chamber inlet butterfly valve will be removed, the inlet channel opened to provide free surface flow into each chamber, and provisions made for the installation of manual, lightweight isolating slide gates. Grit chamber overflow weirs will be replaced with submerged orifices designed to provide sufficient head loss to assure even distribution of the screened sewage flow into all tanks in service.

Each influent control valve will be of the modulating type designed to maintain a constant level in the grit chamber from minimum flow to the peak hydraulic capacity of the plant. Each control valve will be provided with a package hydraulic power unit similar to the screened sewage bypass butterfly valve.

4. Installation of compressed air skimming and automatic scum removal equipment on each aerated grit chamber. Equipment will include two ejector pumps and sufficient glassed lined scum piping to connect pump discharges to the raw sludge force main between the sedimentation tanks and the digesters. Construction will involve a new scum handling gallery under the grit chamber collection channel.

5. Revisions to the grit removal system include the elimination of the grit sumps and installation of two additional cyclonic grit separators, one for each existing classifier. Existing grit chamber removal pumps will be modified to pump directly to separate grit separators. Separator overflows will be returned separately to the screened flow distribution channel. Removal pumps will be designed to provide chamber dewatering when required. The existing grit sumps will be modified to provide for the drainage of individual bar screen channels as required.

6. Modification of the pretreatment building including providing removable covers for the aerated grit chambers, ventilation system revisions and modernization of power and controls. Covers for the aerated grit chambers will be fabricated of lightweight corrosion-proof material, Ventilation system revisions will include the installation of positive supply and exhaust ventilation systems for all areas and odor removal equipment on exhausts from covered aerated channels, covered grit chambers, enclosed area around bar screens and enclosed grit-screenings storage bins. Power and controls will be updated to provide sparkless apparatus in those areas exposed to open sewage surfaces or ventilation from such areas, automatic centralized control for the screen inlet isolating gates, and modification of the pretreatment power control center to provide atmospheric isolation.

7. Construction of new underground piping and conduit tunnel between the grit pump area of the pretreatment structure and the new solids handling gallery beneath the existing sedimentation tanks. The tunnel will provide a route for operators, piping and electrical conduits to travel between the main control building and the pretreatment structure, The new grit chamber scum handling gallery and existing scum and sludge pumping area will be connected into this new tunnel.

8. Modification of the sedimentation tanks to include more efficient scum and sludge collection, submerged effluent launders and modernization of power and controls. Scum collection revisions will include compressed air skimming and automatic scum removal. Sludge collection revisions will include new sludge cross collector channels and equipment for all tanks. New channels will be in existing locations for tanks 1 through 4 and relocated to a similar location in tank 5. New sludge longitudinal equipment will be supplied for tank 5 to bring the sludge to the new cross collector channel. Longitudinal collectors will be submerged to eliminate interference with the air skimming system.

Submerged effluent launders will be provided with orifices, fabricated of fiberglass and designed to operate in conjunction with new plant effluent control valves. Launder orifices will assure uniform distribution of the sewage flow regardless of the number of tanks in service. Power and controls will be updated to

provide sparkless apparatus in those areas exposed to open sewage surfaces, automatic centralized control of scum and sludge collection equipment, and atmospheric isolation of the sedimentation area power control center.

9. Modification of existing sludge and scum handling and pumping facilities by construction of a new solids handling gallery beneath the new sedimentation cross-collector channels. Gallery will house cross-collector drive equipment, scum and sludge pumps and related instrumentation and controls. Sedimentation cross-collectors will be of the screw type designed for variable speed operation with thickening ability. Scum pumps will be pneumatic ejectors. Sludge pumps will be of the progressive cavity, positive displacement type with variable speed drives and will be piped directly via the raw sludge force main to the digesters. Digester circulating sludge will be piped back into the gallery for flushing of scum ejectors and raw sludge pumps. All scum and raw sludge piping will be glass lined. Instrumentation and controls will include timers for sludge collector and scum remover control, sludge blanket and density detectors for raw sludge pump control, and mechanical floats for scum ejector control. All instrumentation signals and controls will be tied into the centralized control system.

10. Construction of a new underground piping and conduit tunnel between the new solids handling gallery beneath the existing sedimentation tanks and the main control building. Tunnel will provide a rout for operators, piping and electrical conduits to travel between the sedimentation area and the main control building. Tunnel will contain a raw sludge heat exchanger, raw sludge meter and digester circulating sludge return meter.

11. Modification of chlorination facilities including additional capacity for pre and postchlorination, installation of a prechlorination system, new chlorine handling pipelines and revisions to postchlorination diffusers and control instrumentation. Chlorination capacity addition will consist of one additional 8000 lb/day chlorinator with chlorine vacuum piping designed to allow any one of the three 8000 lb/day evaporator-chlorinator combinations to standby for any other combination. One of the evaporator-chlorinator combinations will be piped and controlled to provide chlorine gas to a new prechlorination injector located immediately north of the pretreatment structure. The injector will be operated on No.3 water. The prechlorination diffuser will be located immediately upstream from the coarse bar rack. Chlorine handling pipelines for post and bypass chlorination will be changed to handle chlorine gas under vacuum with post and bypass chlorination located in the field at the point of application. Postchlorination diffuser will be relocated and redesigned to maintain efficient application and mixing with a minimum of gas release. Postchlorination will take place downstream from the effluent pumping station where an in-line, propeller type mixer with two propeller agitators will be used to insure mixing of the chlorine with the flow. Instrumentation signals and controls will be tied into the centralized control system. Controls will assure operation of the bypass chlorination system whenever the influent hydraulic control system indicates bypassing is taking place.

12. Construction of an effluent pumping station with sufficient capacity to pump 70 mgd of settled sewage, through a submarine outfall, into the Gulf of the Farallones against the highest tide, an effluent meter, and effluent control valves. Submarine outfall design will require pumping of the effluent only when tide and flow conditions cause the water level in the sedimentation tanks to rise beyond the control of the effluent control valves. Preliminary hydraulic calculations indicate that these conditions will prevail (1) at maximum dry weather flow (42 mgd) only when the tide is at its highest recorded level, and (2) at plant peak hydraulic flow (70 mgd) for all conditions of tide. Gravity discharge of dry weather flows will occur most of the time.

Four variable speed, electric motor driven pumps, each of identical capacity, will be used for effluent pumping. Performance characteristics of these pumps will assure satisfactory and efficient operation at or near their rated capacities with heads varying from zero to 26 feet. Three units will be required to pump the peak rate of input against the head created by the highest recorded tidal elevation.

Both the pump speed and the discharge rate will be controlled by sensitive instrumentation. Under this arrangement, the discharge rate will be held at the same level as the input rate and optimum water surface level will be maintained within plus or minus one-half inch

in the sedimentation tanks. Each of the effluent pumps will be equipped with an automatic check valve, which will be designed to assure positive back flow prevention and to minimize hydraulic resistance when the pumps are operating at their maximum capacity.

Effluent meter will be of the magnetic flow type and will be installed in the effluent piping just upstream from the pumps and control valves. The meter will be used for pre and postchlorination control. Instrumentation will be tied to the centralized control center.

Effluent control valves of the butterfly type will be used to throttle effluent flow to the outfall to maintain sedimentation tank level within plus or minus one-half inch optimum during periods of gravity flow. The valves will be fully closed when effluent pumping is required. Butterfly valves will be provided with individual packaged hydraulic powered positioners similar to the screened sewage bypass butterfly valve unit. Pump speed, sedimentation tank level and valve position instrumentation and controls will be connected to the centralized control system.

13. Revision of the existing outfall system including the construction of an outfall extension consisting of approximately 1200 to 1550 feet of onshore pipeline and 6500 to 7500 feet of submarine pipeline. The submarine pipeline will include 500 feet of diffuser section located about 58 feet below U. S. Coast and Geodetic Survey mean lower low water tidal datum and about one mile due west of Seal Rocks near the entrance to San Francisco Bay.

14. Construction of a new 4200 sq ft administration building with space for reception, office, conference, laboratory, lunch room and washroom facilities. Building materials will be of a permanent nature designed to minimize maintenance and repair. Facilities will provide space for the ultimate administrative staff required.

15. Modification of the existing administration building into the main control building by utilizing existing laboratory, reception and office areas for a centralized control center and electrical and instrumentation repair shops; by enlarging and modernizing the plant power distribution center; by eliminating the elutriation tanks and equipment and providing additional storage space and room for relocating the boilers to this more accesibile area; by eliminating all gas handling equipment except that directly connected with the boilers; by interconnecting the building with the sedimentation structure and digester structure; and by improving the ventilation systems.

Centralized control center will include main graphic and control panels with provisions to monitor and control all critical process operations and automatic devices and assure the safe shut-down of facilities in case of a major malfunction of any critical operation. A centralized communication network including paging, audio, intercommunication and sound powered communication between critical areas throughout the plant will also be included.

Plant power distribution center modernization will include the up-dating of all switchgear found to be obsolete and/or unsafe by present day standards. Main plant power feeders will be designed to be supplied from two separate substation feeders. A 200 KW gas turbine standby generator will be installed in the main control building to provide power for essential services. Non-interruptible battery power will assure instrumentation accuracy and switchgear and control availability at all times.

Low pressure steam boilers designed for operation on either sewage sludge gas or natural gas will be provided to minimize maintenance and operation requirements. Steam will be quickly condensed by hot water heat exchangers. Hot water will be piped around the plant and utilized for digester, raw sludge, and building heating. Ventilation system improvements will include providing air conditioned and filter air for the centralized control center, electrical and instrumentation shops and the plant power distribution center and positive supply and exhaust ventilation for all other areas within the building.

16. Repair and reactivation of No. 2 water system hydropneumatic tank by providing new compressed air supply. Instrumentation and controls will be transmitted to the centralized control center.

17. Installation of new effluent sampling and monitoring devices designed to provide chilled, proportional, composite samples and continuous records of effluent parameters such as D.O., turbidity, pH, temperature, specific conductance and others, as required. Data from all monitors will be transmitted to the centralized control center.

In addition to these sewage treatment process improvements the following revisions and modifications should be made to the solids treatment and disposal at the Richmond-Sunset plant.

18. Cleaning and renovation of both digesters, including the installation of floating steel covers, external ring type piping incorporating multiple transfer points, and better internal mixing by increased circulation of gas. Installation of floating steel covers will include the removal of the existing concrete dome on digester 1 and the removal of the steel gas holding cover on digester 2. New floating covers will be provided with approximately 12 ft of travel and necessary provisions to maintain piping and operator access to the top of the cover in all positions. Sufficient additional gas diffusers will be added to provide a three times increase in the internal mixing velocity gradient.

19. Renovation of sludge and gas handling piping and equipment, electrical apparatus and controls, and the ventilation system within the existing digester operating house. Piping will be simplified to remove all unnecessary valves and fittings. Gas circulation equipment will be provided with greater capacities and moved to more efficient locations. Digested sludge transfer pumps will be of the progressive cavity, positive displacement type with variable speed drives. Gas utilization equipment will be renovated and relocated to within this structure. Electrical controls and equipment will be updated to provide sparkless apparatus within the whole building. Ventilation system revisions will include provisions for positive supply and exhaust ventilation with odor removal equipment on all exhausts.

20. Construction of a new underground piping and conduit tunnel between the main control building and the digester operating house. Tunnel will provide a route for operators, piping and electrical conduits to travel between the main control building and the digester area. Ventilated isolation will be provided to separate the main control building from the digester area.

21. Renovation of the existing sludge filtering system including modifications to the filter vacuum control system and modernization of filter feed mixing and handling equipment and filter cake storage and handling facilities. Filter vacuum modifications will include provisions to assure positive separation of filtrate and reliable vacuum compressor operation.

22. Enlargement and modifications to the chemical handling and storage facilities. Chemical handling modifications will include providing sufficient capacity for the storage of both slaked lime and ferric chloride and provisions for more precise feeding of these chemicals.

23. Installation of digester supernatant and vacuum filter filtrate supplemental treatment facilities. Capacity required when treating Richmond-Sunset sludge on a five-day week, eight hours per day basis will be 5,000 gph. It is anticipated the system used will be an electrolytic wastewater treatment process which will disinfect, oxidize and improve the clarity of the supernatant and filtrate.

Description of Operation. As indicated in Chapter 2, existing plant improvements are not expected to result in major additional manpower requirements for the Richmond-Sunset plant. Some operating manpower will be switched to maintenance and the only additional personnel will involve one specialized maintenance man for electrical and instrumentation repair functions. It is assumed the treatment of Richmond-Sunset wastes utilizes 27 personnel.

With the recommended improvements additional power will be required for the influent control system, grit chamber scum removal, air skimming, effluent pumping and controls, increased digester mixing, increased chemical handling, supernatant and filtrate waste treatment, and ventilation and odor control. Although decreased grit pumping and elimination of digested sludge elutriation will result in reduction in power use for these purposes, it is still expected that power use will increase approximately 800 horsepower over that used in 1969-70.

Other utilities are expected to remain about the same although some additional costs may be involved in supplying supplemental fuel for the boilers and standby generator. Natural gas use is expected to remain at the 1969-70 level.

Effluent chlorine use is expected to remain about at the level presently being used, which is approxiamtely 3200 lbs/day. Chlorine application to the influent is expected to be at the

same rate as applied at the North Point plant. This will result in a chlorine use of approximately 700 lbs/day. For the purposes of this study, it is assumed that bypass chlorination will use approximately 30,000 lbs of chlorine per year. It is expected that salt used for odor control facilities will amount to approximately 4500 lbs/day. Ferric chloride and slaked lime use for filter cake production are expected to average about 0.32 and 2.05 tons per day, respectively.

Normally, it would be expected that maintenance and repair costs would decrease with the construction of the revisions and modifications to the existing plant. The amount presently budgeted is less than normal for plants similar to Richmond-Sunset, however, and no reduction in maintenance costs is anticipated. Establishment of a preventive maintenance program will result in some cost reallocations, but, once established, these are expected to remain fairly constant over a long period of time.

Screenings, grit and sludge filter cake disposal costs will increase. Improvements to each of these systems are expected to increase the efficiency of removal with the result that greater quantities of the material will have to be handled. For the purposes of this study, it is assumed all of the filter cake produced under this alternative may be disposed in Golden Gate Park. Screenings are expected to average about 4 cu ft per mil gal, grit 5 cu ft per mil gal, and filter cake 32.5 tons per day when prorated on a continuous basis. If the screenings are 45 percent solids with a specific gravity of 1.0, disposal loadings are expected to average 6.5 tons per day. Filters are expected to be operated 8 hrs/day, 5 day/week.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for improvements to the existing plant are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative R1

Sewage Treatment		Solids Treatment	
1.	$ 16,000	18.	$ 375,000
2.	120,000	19.	114,000
3.	270,000	20.	120,000
4.	120,000	21.	90,000
5.	45,000	22.	45,000
6.	129,000	23.	198,000
7.	120,000	Subtotal	$ 942,000
8.	300,000		
9.	840,000	TOTAL	$11,831,000
10.	210,000		
11.	78,000		
12.	900,000		
13.	6,832,000		
14.	126,000		
15.	705,000		
16.	15,000		
17.	63,000		
Subtotal	$10,889,000		

If all work must be completed by 1973, these costs should be increased by approximately 25 percent or $3,000,000.

Estimated Operation Costs. Estimated annual operating costs for the improved existing plant are based on 1971 prices and are as follows:

	Alternative R1
Labor	$453,000
Electric Power	71,000
Other utilities (gas, etc)	1,000
Chemicals	108,000
Maintenance, repairs and supplies	30,000
Screening and grit disposal	13,000
Other solids disposal	6,000
TOTAL	$682,000

Alternative R2

The only completely physical treatment process which will produce a higher level of effluent and receiving water quality than existing plant improvements involves combining the improvements listed under alternative R1

with dissolved air flotation of the settled sewage. Although additional solid removals are expected with the combined use of primary sedimentation and dissolved air flotation, no major revisions will be required to any other of the sewage or solid treatment facilities except the sedimentation effluent control valve and the effluent pumping station, supernatant and filtrate electrolytic waste treatment process. Filter operation will increase to about ten hours a day, five days a week.

Reductions Expected. Upon completion of all proposed existing plant improvements, effluent pumping and outfall extension, and the installation of the dissolved air flotation facilities, it is expected that the following objectives can be attained at the Richmond-Sunset plant.

Alternative R2

Parameter	Objectives
Turbidity and color	Less than 30 percent reduction in receiving water clarity.
Floatables	Approximately 20 mg/sq meter floatables in the receiving water.
Grease	Less than 30 mg/l grease in plant effluent.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative R2 which involves the existing plant improvements plus dissolved air flotation, includes the following sewage treatment construction:

1. Construction of improvements to the existing Richmond-Sunset plant as listed under items 1-17, alternative R1, with the operating head of the effluent pumps increased to 30 ft.

2. Installation of a sedimentation tank effluent control system designed to maintain water level in the tanks to plus or minus one-half inch and relocation of the effluent control valves. Control system will consist of control valves of the butterfly type used to throttle the flow between sedimentation and flotation tanks. Butterfly valves will be provided with individual packaged hydraulic powered positioners similar to the screened sewage bypass butterfly valve unit of item 3, alternative R1. Sedimentation tank level and valve position instrumentation and controls will be connected to the centralized control system.

3. Installation of six dissolved air flotation tanks, any five of which will be capable of providing a 2 gpm/sq ft overflow rate at 70 mgd. Each flotation tank inlet will be equipped with a diffusion baffle and a perforated distribution baffle to separate the mixing zone from the flotation zone. Recycled air-charged effluent will be introduced to the settled sewage in the mixing zone at rates up to 40 percent of PDWF, or approximately 3.4 mgd per tank. Pressurizing of the recycle flow will take place in six units, one for each tank. Each pressurizing unit will include a recycling pump, a pressurizing tank and necessary meters and controls. Air for the six units will be supplied by three heavy-duty, single stage, water-cooled compressors designed for operation at not less than 60 psi.

Scum removal from the flotation tank surface will be accomplished by mechanical skimmers which will travel the complete length of the tank. No sludge removal equipment will be installed. Scum from each tank will be collected in individual hoppers by helical removers and pumped directly to the raw sludge force main. Scum pumps will be of the progressive cavity, positive displacement type with variable speed drives. Scum piping will be glass lined and will include a flow measuring meter.

Effluent will be removed from the flotation tanks through a series of submerged launders with orifice inlets. From the launders, the effluent will enter a collection channel which will be directly connected to the effluent pumps. Pump speed and effluent bypass control valve will be controlled to maintain water surface elevation in the flotation tank within a range of plus or minus one-half inch.

The dissolve air flotation system will be housed in a separate structure and provided with a positive supply and exhaust ventilation system. Deodorizing facilities will be provided for all ventilation exhaust. Power, controls and instrumentation will be connected to the centralized control system.

In addition to these sewage treatment process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Richmond-Sunset plant:

4. Construction of improvements to the existing Richmond-Sunset plant as listed under items 18-23, alternative R1, with the electrolytic wastewater treatment process for digester supernatant and vacuum filter filtrate increased in capacity to 6000 gph.

Description of Operation. The operation of the existing plant improvements and dissolved air flotation treatment process as described for alternative R2 is expected to require two additional operators beyond those required for alternative R1. It is anticipated that the additional personnel will be utilized as maintenance operators to provide preventive maintenance for the additional equipment and structures involved.

In addition to the extra horsepower required by the existing plant improvements of alternative R1, alternative R2 will require power for additional compressing, skimming, and pumping of scum, additional ventilation and deodorizing requirements, the settled sewage control valves, and larger electrolytic treatment facilities. It is expected that 1969-70 power use will increase approximately 1500 horsepower for this alternative. Other utilities, including natural gas, are expected to remain the same as determined for alternative R1.

No change is anticipated in the use of chlorine between alternative R1 and R2. Salt required for odor control facilities is expected to increase to approxiamtely 8300 lbs per day, while ferric chloride and slaked lime use for filter cake production are expected to increase to an avergae of 0.4 and 2.5 tons per day, respectively. Changes in maintenance and repair costs between alternatives R1 and R2 are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives R1 and R2. It is anticipated that alternative R2 will require the filters to be operated ten hours per day, five days per week. Filter cake production, when prorated to a continuous basis, will average 40 tons per day, or approximately 7.5 tons per day beyond park utilization capacity.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative R2 which provides for improved treatment efficiency through use of dissolved air flotation plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative R2

Sewage Treatment		Solids Treatment	
1.	$10,889,000	4.	$ 982,000
2.	30,000	Subtotal	$ 982,000
3.	2,850,000	TOTAL	$14,751,000
Subtotal	$13,769,000		

The costs above do not include any allowance for purchase of land required for dissolved air flotation structures. If all work must be completed by 1973, these costs should be increased by approxiamtely 25 percent, or $3,700,000.

Estimated Operation Costs. Estimated annual operating costs for the improved existing plant and dissolved air flotation are based on 1971 prices are as follows:

	Alternative R2
Labor	$486,000
Electric Power	104,000
Other utilities (gas,etc.)	1,000
Chemicals	130,000
Maintenance, repairs and supplies	37,000
Screening and grit disposal	13,000
Other solids disposal	18,000
TOTAL	$789,000

Alternative R3

The least expensive capital cost alternative which will produce a level of effluent and receiving water quality higher than that produced by alternative R1 involves combining alternative R1 improvements with low dose ferric chloride chemical treatment. Low dose ferric chloride chemical treatment involves addition of 15-45 mg/l ferric chloride together with salt water and polymer to the raw sewage, just prior to its passing through the influent control valves, and gentle flocculation of this mixture in the first 20 feet of the sedimentation tanks. Although the solids from the sedimentation tanks are expected to average 3.5

percent and to increase in volume, it is anticipated that the improved digesters will be able to assimilate the additional load. Because of the difficulty of dewatering digested sludge containing a large percentage of ferric chloride floc, heat conditioning of the sludge prior to filtering is proposed. The heat conditioning process is described under alternative N2 for the North Point plant. Electrolytic wastewater treatment will be utilized to treat the digester supernatant, heat conditioning decant, and vacuum filter filtrate.

Reductions Expected. Upon completion of all the proposed existing plant improvements, effluent pumping and outfall extension, and the installation of low dose ferric chloride chemical treatment, it is expected that the following objectives can be attained at the Richmond-Sunset plant:

Alternative R3

Parameter	Objectives
Turbidity and color	Approxiamtely 20 percent reduction in receiving water.
Floatables	Approximately 15 mg/ sq meter flotables in the receiving waters.
Grease	Effluent concentration between 15 and 30 mg/l
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative R3, which involves existing plant improvements plus low dose ferric chloride chemical process, includes the following sewage treatment construction:

1. Construction of improvements to the existing Richmond-Sunset plant as listed under items 1-17, alternative R1.

2. Installation of chemical storage and feeding facilities, including chemical metering pumps, fiberglass chemical storage tanks and automatic controls. It is anticipated that the ferric chloride will be supplied, stored and fed in the liquid form.

3. Installation of salt water pumping facility designed to maintain 1200-1500 mg/l NaCl level in the plant influent. Permanent installation will consist of at least two variable speed pumps, each capable of pumping up to 4 mgd of ocean water. Station will be located within the effluent pumping station with the salt water intake laid alongside of the submarine outfall. Automatic controls will be tied to the centralized control center.

4. Installation of storage and feeding facilities for applying 0.25 mg/l of polymer.

5. Installation of mechanical flocculation equipment in the first 20 feet of the existing sedimentation tanks. Flocculators will be installed to operate in the reverse direction ten minutes of every hour. They will be installed above the existing collection equipment which will remain in place and in operation. Flocculator impellers will be designed to de-rag when operated in reverse.

In addition to these sewage treatment process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Richmond-Sunset plant:

6. Construction of improvements to the existing Richmond-Sunset plant as listed under items 18-21, alternative R1, with the electrolytic wastewater treatment process for digester supernatant and filtrate increased in capacity to 12,000 gph.

7. Installation of sludge heat conditioning facilities, including solids disintegration, heat exchangers, pumps, control valves, reactor vessels, treated sludge storage and decanting tank, pressure ventilation and deodorization, and necessary controls. Facilities will have a capacity of 9000 gph.

Description of Operation. The chemical treatment process proposed under alternative R3 will require little additional manpower. It is anticipated the requirements of the additional chemical handling equipment and solids heat conditioning treatment will add no more than two personnel in addition to those required under alternatice R1.

Alternative R3 will require more power than alternative R1 because of the pumping of approximately ten percent of the flow as salt water from the ocean, flocculating equipment, heat conditioning equipment, and additional electrolytic equipment for supernatant, decant and filtrate wastes. It is estimated the extra power over 1969-70 use will involve the continuous running of approximately 1300 horsepower. As long as the digesters stay reasonably healthy, no change is expected on the demands for the other utilities.

Chlorine use under alternative R3 will remain the same as alternative R1. No salt for odor control purposes will be required since a portion of the ocean water delivered to the plant can be diverted to provide these requirements. Approximately 2.8 tons per day of ferric chloride and 32 lbs per day of organic polymer will be required to provide the necessary chemical treatment. No chemicals will be required for filter cake production. Changes in maintenance and repair costs between alternatives R1 and R3 are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives R1 and R3. It is expected that alternative R3 will require the filters to be operated only seven hours per day, five days per week. Filter cake is expected to average on a prorated continuous basis, approximately 27 tons per day. This lower filter cake volume reflects both the production of a dryer cake and the absence of filter assisting chemicals. It is anticipated all of this filter cake will be used by the park system.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative R3 which provides for improved treatment efficiency through the use of low dosed ferric chloride chemical treatment are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative R3

Sewage Treatment		Solids Treatment	
1.	$10,889,000	6.	$ 1,174,000
2.	95,000	7.	1,200,000
3.	130,000	Subtotal	$ 2,374,000
4.	24,000		
5.	165,000	TOTAL	$13,657,000
Subtotal	$11,303,000		

If all work must be completed by 1973, these costs should be increased by approximately 25 percent or $3,250,000.

Estimated Operating Costs. Estimated annual operating costs for the improved existing plant and low dose ferric chloride chemical treatment are based on 1971 prices and are as follows:

	Alternative R3
Labor	$486,000
Electric power	97,000
Other utilities (gas, etc)	1,000
Chemicals	163,000
Maintenance, repairs and supplies	33,000
Screening and grit disposal	13,000
Other solids disposal	5,000
TOTAL	$798,000

Alternative R4A

The most compact biological treatment process which will produce a level of effluent and receiving water quality capable of meeting the most stringent requirements of the Regional Board at the Richmond-Sunset plant, except the one for effluent grease, involves combining the existing plant improvements with activated sludge biological treatment. Activated sludge biological treatment involves the mixing of settled sewage in aerobic aeration tanks with return sludge from the secondary sedimentation tanks and the settling of the mixed liquor solids in secondary sedimentation tanks. Aeration tanks will operate on loadings up to 50 lbs applied BOD/1000 cu ft per day. Returned sludge reaeration facilities will be provided. Secondary sedimentation tanks will have an overflow rate of 2000 gal/sq ft/day for PWWF. Flotation type thickeners for the waste activated sludge will be designed for loadings of 20 lbs/sq ft/day.

Reductions Expected. With the completion of all the proposed existing plant and outfall improvements and the installation of biological activated sludge treatment improvements, it is expected that the following objectives can be attained at the Richmond-Sunset plant:

Alternative R4A

Parameter	Objectives
Turbidity and color	Less than 5 percent reduction in receiving water clarity.
Floatables	Less than 10 mg/sq meter floatables in the receiving water.
Grease	Effluent concentration approximately 5 mg/l.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative R4A, which involves existing plant improvements plus the activated sludge biological process, includes the following sewage treatment construction:

1. Construction of improvements to the existing Richmond-Sunset plant as listed under items 1-17, alternative R1, with the operating head of the effluent pumps increased to 30 ft.
2. Installation of a sedimentation tank effluent control system as recommended in item 2, alternative R2.
3. Installation of an activated sludge biological treatment system complete with aeration and secondary sedimentation facilities.

Aeration facilities will include two rectangular-reinforced concrete tanks, each of which is expected to be approximately 200 ft long, 93 ft wide and 15 ft deep, and will be divided by intermediate curtain walls into four passes. Each aeration tank will have a hydraulic capacity of 35 mgd.

Diffused air will be supplied by retractable air diffuser assemblies through coarse bubble diffusers to the bottom of the tank. Retractable assemblies will permit maintenance and cleaning of the diffusers without taking the tanks out of service and will be mounted on the tank struts. Assemblies will be arranged to locate the diffusers so as to provide agitation and diffusion in a manner which will eliminate the possibility of flow short circuting through the tanks. Main air headers supplying the retractable assemblies will be installed at the top of alternate tank passes and valves and meters will be provided on each lateral to enable adjustment os air rate automatically in relationship to the dissolved oxygen level in the tank pass. Polargraphic DO probes will be provided to monitor each tank pass. Adequate tank drains will be provided.

Aerated settled sewage channels around three sides of the two tanks will permit incremental addition of settled sewage to each pass of each tank. The settled sewage channel at the effluent end of the aeration tank will be paralleled by mixed liquor and return activated sludge channels and by an equipment gallery which will contain air headers, aeration and agitation air blowers, return sludge pumps, and other related equipment. Settled sewage, mixed liquor and return sludge channels will be designed for minimum velocities to reduce hydraulic losses. All channels will be aerated to prevent deposition of solids. Diffusers for channel agitation will be mounted on removable assemblies which will permit maintenance and cleaning of the diffusers without taking the channels out of service.

Water sprays will be installed in each pass of each aeration tank and in all aerated channels to supress foam. The sprays will use low pressure No. 3 water to which a suppressing chemical may be added as required.

Aeration air will be provided by eight electric motor driven, multi-stage, centrifugal blowers located in the equipment gallery of the aeration tank. Any seven blowers will be capable of supplying aeration air at the rate of 1200 cu ft per lb of BOD removed. Aeration blower output will be regulated by throttling the blower inlet to maintain a set operating pressure in the supply air header. Oil wetted intake air filters will be provided to remove any air particles which might damage the blowers or clog the coarse bubble diffusers. Automatic external bypasses will be provided on each blower to protect against surging during start-up and excessive throttling.

Settled sewage and return activated sludge distribution to the aeration tanks will be controlled hydraulically to provide proportional or uniform applications as required. Mixed liquor will be discharged from the aeration tanks over weirs of sufficient length to minimize variations in aeration tank water surface elevations.

Secondary sedimentation will take place in four circular reinforced concrete tanks. Each tank will have a diameter of 120 ft and a side water depth of 20 ft. Any three tanks will be able to handle the PWWF with an overflow rate of 2000 gal per sq ft per day. The tanks will be arranged in a single battery of four fed from the aeration mixed liquor channel by a single center channel.

Mixed liquor will be introduced at the center of the secondary sedimentation tanks through a baffling structure and effluent will be collected by orifices mounted in double concentric submerged launders arranged to provide maximum solids removal efficiency. Sludge will be continuously removed by a rotating hollow tube fitted with orifices and a squeegee. The rate of sludge removal will be automatically controlled to maintain a preset sludge blanket level. Sludge will be withdrawn by low lift propeller pumps with variable speed

drives located in the equipment gallery of the aeration gallery, metered and then discharged to the return activated sludge channel. Convenient means will be provided for sampling and visual observation of the return activated sludge and mixed liquor. Excess activated sludge or mixed liquor will be wasted be means of variable speed, progressive cavity, positive displacement pumps to the flotation thickeners.

Automatic skimming will be provided on each secondary sedimentation tank with the scum removed directly to ejectors for discharge to the raw sludge force main. Effluent collection orifices will be designed to provide sufficient head loss to assure even distribution of the mixed liquor regardless of the number of tanks in service. Effluent from the submerged launders will enter a collection channel which will be directly connected to the effluent pumps. Pump speed and effluent bypass control valve will be controlled to maintain water surface elevation in the sedimentation tanks within a range of plus or minus one-half inch.

The activated sludge biological treatment facilities will be uncovered except for the return activated sludge collection and distribution channel. This will be covered by lightweight, corrosion resistant aluminum panels. The air from under the covers will be exhausted through the aeration blowers to the mixed liquor in the aeration tanks. All instrumentation and controls will be transmitted to the centralized control center.

In addition to these sewage treatment process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Richmond-Sunset plant:

4. Installation of at least two air flotation thickening units to provide 1000 sq ft of tank surface including adequate standby. Each tank will be provided with top scum and bottom sludge collection and removal equipment, settled sewage and compressed air dissolving equipment, and automatic controls. Tanks will be completely housed and provided with positive ventilation and odor control equipment. Thickener overflow will be directed to the primary sedimentation tank influent.

5. Construction of improvements to the existing Richmond-Sunset plant as listed under items 18-23, alternative R1, with the electrolytic wastewater treatment process for digester supernatant and filtrate designed for a maximum capacity of 6000 gph.

Description of Operation. The activated sludge biological treatment process with existing plant improvements proposed under alternative R4A will require more manpower than the other alternatives providing lesser treatment. It is anticipated the biological treatment facilities and the related flotation thickening facilities will require the equivalent of one full time maintenance operator in addition to the other personnel required for alternative R1. With continuous duty, this position alone will entail the addition of at least five new personnel.

More power will be required for operation under alternative R4A than under R1. Extra power demand will result from the aeration and agitation air blowers, the return activated sludge pumps, the secondary sedimentation tank drives, the flotation thickener pumps, compressors and ventilating and deodorizing equipment, the larger electrolytic treatment facilities, and the extra head on the effluent pumps. It is expected that 1969-70 power use will increase approximately 2200 horsepower for these improvements. Other utilities, including natural gas, are expected to remain the same as determined for alternative R1.

Chlorine requirements for disinfection are expected to be appreciably less than for alternatives providing a lesser degree of treatment. Chlorine use for disinfection is expected to be reduced to about 8 mg/l. or about 1860 lbs per day. Influent and bypass chlorine use is expected to remain the same as alternative R1. Salt use will increase to approximately 6000 lbs per day. Ferric chloride and slaked lime use for filter cake will increase to an average of 0.44 and 2.75 tons per day, respectively. Changes in maintenance and repair costs between alternative R1 and R4A are expected to parallel the investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives R1 and R4A. It is anticipated that alternative R4A will require the filters to be operated approximately eleven hours per day, five days per week. Filter cake production, when prorated to a continuous basis, will average 44 tons per day, or approximately 11.5 tons per day beyond park utilization capacity.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative R4A, which provides for improved treatment efficiency through use of activated sludge biological treatment plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative R4A

Sewage Treatment		Solids Treatment	
1.	$10,889,000	4.	$ 210,000
2.	30,000	5.	982,000
3.	8,100,000	Subtotal	$ 1,192,000
Subtotal	$19,019,000	TOTAL	$20,211,000

The costs above do not include any allowance for purchase of land required for structures for biological treatment. If all work must be completed by 1975, these costs should be increased by approximately 25 percent or $6,400,000.

Estimated Operating Costs. Estimated annual operating costs for the improved existing plant and activated sludge biological treatment are based on 1971 prices and are as follows:

	Alternative R4A
Labor	$534,000
Electric power	169,000
Other utilities (gas, etc)	1,000
Chemicals	100,000
Maintenance, repairs and supplies	51,000
Screening and grit disposal	13,000
Other solids disposal	25,000
TOTAL	$893,000

Alternative R4B

The most compact chemical physical treatment process which will produce a level of effluent and receiving water quality meeting all the most stringent requirements of the Regional Board of the Richmond-Sunset plant involves combining the existing plant improvements with high dose lime chemical treatment and recalcining incineration. High dose lime chemical treatment involves dosage of the screened sewage prior to preaeration and sedimentation with 240 to 280 mg/l of slaked lime, recycling of up to 25 percent of the ADWF through the preaeration flocculator, and recarbonation of the effluent prior to effluent pumping and postchlorination. One additional sedimentation tank is required to assure reasonable sedimentation tank overflow rates at PWWF. The first 20 ft of all tanks will be modified to preaeration tanks to provide the flocculation required to maintain the proper lime slurry. Solids produced will be increased substantially over other alternatives and major alterations to the sludge handling and disposal facilities will be required. The low magnesium content of the Richmond-Sunset raw sewage eliminates soluble calcium loss, reduces magnesium hydroxide precipitation and therefore increases the fraction of calcium oxide in the product as well as the total CaO recovery. These effects, when combined with the immediate use for all of the available recalcined lime in the process, makes it practical to provide for recalcining at the Richmond-Sunset plant. Facilities for sedimentation solids removal and disposal will be designed to allow for the recirculation of the preaeration underflow.

Reductions Expected. With the completion of all the proposed existing plant improvements, effluent pumping and outfall extension, and the installation of high dose lime chemical treatment, it is expected that the following objectives can be attained at the Richmond-Sunset plant:

Alternative R4B

Parameter	Objectives
Turbidity and color	Less than 5 percent reduction in receiving water clarity.
Floatables	Less than 10 mg/sq meter floatables in the receiving water.
Grease	Less than 5 mg/l in plant effluent
Settleable matter	Compliance with all objectives

Description of Construction. Alternative R4B which involves existing plant improvements and high dose lime chemical treatment, includes the following sewage treatment construction:

1. Construction of improvements to the existing Richmond-Sunset plant as listed under items 1-17 under alternative R1.

2. Installation of chemical storage and feeding facilities, including storage hoppers, a conveying system, weighing hoppers, slaker feeders, and automatic controls. It is a anticipated that two overhead hoppers will provide a combined storage capacity of 150 cubic yards of calcium oxide and will be equipped with vibrators and distributors to insure full utilization of available volume. Calcium oxide will be transferred pneumatically from bulk delivery trucks to the hoppers and from the incinerator recalcining equipment to the hoppers. From the hoppers the CaO will be conveyed to weighing hoppers located directly over the slakers. The slakers will incorporate gravimetric type feeders and will be located directly over the grit chamber collection channel immediately upstream from the influent control valves. Immediately after lime addition, the flow will be rapidly mixed hydraulically as it passes through the head dissipating control valves. All calcium oxide handling facilities will be designed for dust free operation with minimum maintenance and a peak feeding rate of 2.8 tons per hour.

3. Installation of a sixth sedimentation tank complete with submerged effluent collection, air skimming, automatic scum and sludge removal, and scum and sludge handling gallery as recommended for the existing tanks in items 8 and 9, alternative R1.

4. Installation of new preaeration flocculation facilities in the first 20 ft of the sedimentation tanks. Preaeration flocculation will be provided by new sparger diffusers installed along both bottom sides of each tank.

5. Installation of preaeration flocculator recycling facilities capable of recirculating up to 7 mgd of 5 percent underflow through the lime mixing and flocculation system. Six pumps will be variable speed and system controls will be designed to maintain a one percent level of lime sludge slurry in the preaeration reactor.

6. Installation of recarbonation facilities including fiberglass carbon dioxide CO_2 to the flow immediately downstream from the sedimentation effluent collection channel. The recarbonation system will be capable of lowering the effluent pH to approximately 8.5. Carbon dioxide system capacity will be at least 18.0 tons per day with 48 tons of chilled storage capacity. Carbon dioxide will be diffused into the flow by eight stainless steel mixing diffusers designed to assure maximum assimilation. 1250 sq ft of contact chamber area with approximately three minutes of retention at PWWF will be provided. Liquid CO_2 will be delivered by truck tanker.

In addition to these sewage treatment process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Richmond-Sunset plant:

7. Renovation of the 100 ft dia primary digester to a 4200 sq ft gravity thickener complete with false bottom and enclosure. Thickening facilities will include automatic sludge and scum removal and pumping equipment, overflow and disposal piping, and instrumentation and controls. Thickener overflow will be directed to the grit chamber collection channel immediately upstream from the influent control valves.

8. Cleaning and renovation of the 80 ft dia secondary digester to act as a raw sludge holding tank. Work will include the installation of a steel floating cover, high energy gas mixers, adequate piping, improved circulation and transfer piping and necessary controls.

9. Construction of new underground piping and conduit tunnel as recommended under item 10, alternative R1.

10. Enlargement of the existing sludge filtering system to include the installation of three 8 x 14 ft vacuum filters complete with necessary supporting equipment. The three filters will be able to handle the plant load by operating approximately 10 hours per day, 5 days a week.

11. Installation of vacuum filter filtrate electrolytic treatment facilities for 8,000 gph maximum flow.

12. Installation of two 77.5 dry tons per day, 22.25 ft dia, eight hearth incinerators with recalcining equipment. Incinerators will include equipment to handle screenings and grit, access platforms, instrumentation and controls, and gas stack scrubbers and afterburners, and will maintain a plumeless stack discharge complying with all present air pollution regulations. Ash storage and loading facilities and a pneu-

matic conveying system for moving the recalcined lime to the lime storage hoppers will be included. The two incinerators will provide complete standby capacity. Instruments and controls will be tied to the centralized control center.

Description of Operation. The chemical treatment process and solids disposal system under alternative R4B will require more manpower than any of the other alternatives. It is anticipated the calcium oxide handling and mixing facilities, the recarbonation facilities, and the solids thickening, filtering and incinerating facilities will require the equivalent of two full time maintenance operators in addition to the other personnel required for alternative R1. With continuous duty, these maintenance operator positions will entail the addition of at least 10 new personnel.

More power will be required for operation under alternative R4B than under R1. Extra power use will result from the chemical handling facilities, additional sedimentation tank operation, preaeration underflow recycling, carbon dioxide diffusion, additional solids filtering and the incineration and recalcining facilities. If the preaeration underflow recycling averages ten percent of the plant flow, it is estimated the extra power requirements above the 1969-70 use will approximate 1700 horsepower on a continuous basis. Other utility costs are expected to remain about the same as for alternative R1, except for the use of 2250 Therms/day of natural gas by the recalcining incinerator.

Influent and bypass chlorine use under alternative R4B will remain the same as alternative R4A. Salt requirements for odor control will drop to approximately 3000 per day because control systems will no longer be required for the digester operating area. It is estimated that with the use of 19 tons per day of recalcined lime, alternative R4B will require only eight tons per day of new calcium oxide. No chemical will be required for filter cake production. Carbon dioxide is expected to average about 7.2 tons per day.

Changes in maintenance and repair costs between alternatives R1 and R4B are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will be eliminated under alternative R4B by providing capacity within the incinerator to burn them to ash with the sludge filter cake. Screenings and grit are expected to provide an average additional incineration load of approximately ten tons per day of wet solids. The incinerator system is expected to produce an average of approximately 23 tons per day of damp ash (20 percent moisture) to be hauled to land fill disposal.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative R4B which provides for improved treatment efficiency through use of high dose lime chemical treatment plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices:

Alternative R4B

Sewage Treatment		Solids Treatment	
1.	$10,889,000	7.	390,000
2.	120,000	8.	165,000
3.	465,000	9.	120,000
4.	120,000	10.	450,000
5.	42,000	11.	315,000
6.	420,000	12.	4,065,000
Subtotal	$12,056,000	Subtotal	$ 5,505,000
		TOTAL	$17,561,000

The costs above do not include any allowance for purchase of land required for incineration structures. If all work must be completed by 1975, these costs should be increased by approximately 25 percent or $4,400,000.

Estimated Operating Costs. Estimated annual operating costs for the improved existing plant and high dose lime chemical treatment with recalcining incineration are based on 1971 prices and are as follows:

	Alternative R4B
Labor	$615,000
Electric power	124,000
Other utilities (gas,etc)	58,000
Chemicals	199,000
Maintenance, repairs and supplies	44,000
Screening and grit disposal	----
Other solids disposal	38,000
TOTAL	$1,078,000

Summary

Table 6-3 presents the predicted plant performance for each of the alternatives proposed for the Richmond-Sunset plant. Table 6-4 summarizes estimated construction and operating costs of the alternatives.

Table 6-3

Predicted Performance of Alternative Treatment Processes, Richmond-Sunset Water Pollution Control Plant

Alternative	Percent reduction in receiving water clarity	Floatable concentration in receiving water, mg/sq meter	Grease concentration in effluent, mg/l	Settleable matter in effluent, ml/l		
				a	b	c
R1	< 30[d]	30[d]	> 30	< 1.0[e]	< 0.5[e]	> 0.4
R2	< 30[d]	20[d]	< 30[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
R3	20[d]	15[d]	15-30[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
R4A	< 5[e]	< 10[e]	5-10[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
R4B	< 5[e]	< 10[e]	< 5[e]	< 1.0[e]	< 0.5[e]	< 0.4[e]

[a] Maximum in any one sample.

[b] Arithmetic average of any six or more samples collected on any day.

[c] 80 percent of all individual samples collected during maximum daily flow over any 30-day period.

[d] Meets minimum stipulated objective.

[e] Meets maximum stipulated objective.

Table 6-4

Estimated Construction and Operating Costs of Alternative Treatment Processes, Richmond-Sunset Water Pollution Control Plant

Alternative	Estimated construction cost, dollars[a]	Estimated annual operating cost, dollars
R1	11,831,000	682,000
R2	14,751,000	789,000
R3	13,657,000	798,000
R4A	20,211,000	893,000
R4B	17,561,000	1,078,000

[a] No land costs included. See appendix E2 for additional area required for each alternative.

SOUTHEAST WATER POLLUTION CONTROL PLANT

The high solids concentration in the influent and the requirement of treating the overflow from the thickeners for North Point solids must be taken into consideration in developing alternative treatment schemes for the Southeast plant. Of the many alternatives discussed and studied, the following six seemed the most logical for economic analysis:

Alternative	Description
S1	Existing plant revisions with effluent pumping modifications and existing outfall improvements.
S2A	Existing plant, effluent pumping and outfall improvements plus dissolved air flotation treatment with a 33-50 percent recycle rate, a maximum surface loading rate of 2 gpm/sq ft not including recycle flow, and an air pressure of 60 psi.
S2B	Existing plant, effluent pumping and outfall inprovements plus chemical treatment with low dose ferric chloride (15-45 mg/l). polymer (0.25 mg/l) for 12 hours per day and salt water (1200-1500 mg/l NaCl). Ferric chloride, polymer, salt water addition and sewage flocculation will be halted during periods of PWWF.
S3	Existing plant, effluent pumping and outfall improvements plus biological treatment utilizing the activated sludge process with secondary sedimentation.
S4A	Existing plant, effluent pumping and outfall improvements plus chemical treatment with high dose lime (450-550 mg/l), recarbonation and solids incineration.
S4B	Existing plant, effluent pumping and outfall improvements plus chemical treatment with high dose ferric chloride (100-150 mg/l) polymer (0.50 mg/l), and salt water (1200-1500 mg/l NaCl) with filtration.

All alternatives were studied on the basis of ADWF 36 mgd, PWWF 70 mgd and total suspended solids at ADWF of 420 mg/l.

Alternative S1

The most economical treatment process for the Southeast plant is to retain and improve the existing plant, modify the existing effluent pumping station and improve the existing outfall. Chapter 3 of Report 2, Phase I, listed eleven specific modifications to improve the efficiency and reliability of the existing plant. As indicated for the other plants, we believe the evaluation of present plant operations and processes in Chapter 2 of this report confirms the Report 2 conclusions and indicates that some of the originally listed modifications require expansion.

Reductions Expected. Once all of the proposed existing plant, effluent pumping and outfall improvements are complete, it is expected that the following objectives can be attained at the Southeast plant:

Alternative S1

Parameter	Objectives
Turbidity and color	Less than 30 percent reduction in receiving water clarity.
Floatables	Approximately 25 mg/ square meter floatables in the receiving water.
Grease	Greater than 30 mg/l grease in plant effluent
Settleable matter	Less than 1.0 ml/l/hr in effluent samples at all times. An arithmetic average of less than 0.5 ml/l/hr in any six or more samples collected on any day. Doubtful that 80 percent of all individual samples collected during maximum flow over any 30-day period will be at or below 0.4 ml/l/hr.

Description of Construction. Existing plant improvements, effluent pumping and outfall

extension includes the following sewage treatment construction:

1. Rehabilitation of the two main influent control gates. Work will include installation of isolating slide gates, rebuilding or replacement of all guides, seating faces and wedges and the modification of the hydraulic control system to provide for throttling during PWWF in conjunction with the new effluent control system.

2. Installation of a pump room dewatering system, magnetic flow meters on each pump discharge, and individual inlet isolating valves on each raw sewage pump. Dewatering system will handle surplus water from pump cleaning, room washdown and seal water leakage and will be provided with non-clog centrifugal pumps capable of handling stringy material and as large a size of sphere as possible. Magnetic meters will monitor plant flows and provide feed back signal for pump speed control system. Sum of flows through meters will be used to control pre and postchlorination systems and the effluent dilution pump. Instrumentation will be tied to the centralized control center. Isolating valves will be of the thin wafer type with 100 percent opening. Wafer and valve seat will be fabricated of stainless steel and entire valve assembly will be fabricated to mount directly between the pump intake and the pump room floor.

3. Removal of the automatic bar screens from the headworks building and remodeling of the central part of the building to house new centralized power, control and communication systems with graphic and control panels for the sewage treatment operation of the Southeast plant and and instrument repair shop. Centralized power and control will include provisions to monitor and control all critical process operations and automatic devices and assure the safe shutdown of the facilities in case of a major malfunction of any critical operation. Centralized communication network will include paging, audio, intercommunication and sound powered communication between critical areas throughout the plant.

Coarse bar rack and pump room area of structure will be physically isolated from the control center. All electrical apparatus in those areas exposed to raw sewage or raw sewage atmosphere will be made spark free. Positive supply and exhaust ventilation from coarse bar rack area will be deodorized. Control center and instrument repair shop area will be air conditioned.

4. Modification of pump control system to take advantage of the higher influent sewer water levels during periods of high flows. Pump sump level will be allowed to rise approximately to the crown of influent sewer at PWWF. At other times the level will vary as required to keep inlet channel velocities and sump agitation sufficient to eliminate solids deposition.

5. Installation of duplicate sources of electric power to the main power substation and a 800 KW gas turbine standby power generator. The standby power generator will be installed in the existing grit washing building near the headworks building and electrical substation and will be designed to provide emergency power for essential services. Non-interruptible battery power will be provided to assure instrumentation accuracy and switchgear and control availability at all times.

6. Installation of a new pump discharge structure with provisions for individual isolation of each pump discharge, flow distribution to four automatic bar screens and flow collection for transportation to the grit chambers. New structure will be centered on the extension of the centerline between the two sedimentation buildings on the road side of the existing grit chambers. Each pump discharge will have its own flap gate and isolating slide gate and the entire structure will be of sufficient elevation to assure gravity flow through the existing grit chambers. A common distribution channel will interconnect the four individual pump discharges with four automatic bar screens and will be the point where all solids thickener overflows and treated supernatant and filtrate from the solids treatment processes re-enter the sewage treatment system. All such flows will be metered prior to discharge to the channel. Each bar screen will be provided with its own inlet and discharge isolating slide gate. Bar screen operation will be controlled automatically by the differential pressure across the screen. A common collection channel will interconnect the discharges from all bar screen channels and will be designed to divide the flow between the existing and new grit chambers. A bypass connection will be provided between this discharge structure collection channel and the grit chambers collection channel. Collection, bar screen and distribution channel water level will be controlled by the grit chamber level control valves on the downstream side of the grit chamber and collection channel.

Discharge structure channels will be air agitated to minimize solids deposition and will have free flow surfaces to eliminate scum accumulation. The pump discharge chambers and aerated channels will be covered with removable lightweight covers. Air from these areas and from the lightweight aluminum or fiberglass enclosed bar screen housings will be powered exhausted through deodorizing equipment. Screening collected by the bar screens will be belt conveyed to relocated grit and screening hoppers. Conveyor belts will be covered by lightweight aluminum or fiberglass housings and positively exhausted with the grit and screen hoppers.

The access road to the north corner of sedimentation building No.1 and the chlorination building will be relocated around the new pump discharge structure.

7. Modification of the existing grit chambers and construction of two new identical chambers, opposite hand, at the influent end of sedimentation building No. 1. When completed the existing and new chambers will be symmetrical about the centerline of the existing grit chamber collection channel. The new chambers will be provided with an inlet division section, grit collection equipment and grit pumping station. An aerated influent channel will connect the inlet section of each set of chambers to the discharge structure collection channel. Both existing and new chambers will be equipped with cross baffles, aeration equipment, scum removal equipment and submerged orifices. Existing tank overflow weirs will be abandoned. Scum removal equipment will include compressed air skimming and automatic scum removers for each tank and two progressive cavity, positive displacement pumps and glass lined scum piping to connect the pump discharges to the raw sludge force main. The submerged orifices will be designed to provide sufficient headloss to assure even distribution of flow into all tanks in service. The orifices will discharge into the common aerated grit chamber collection channel. The outlets from the grit chamber collection channel will be two grit chamber level control valves designed for modulating service.

Each grit chamber level control valve will be of the modulating type designed to maintain a constant level in the grit chambers from minimum flow to the peak hydraulic capacity of the plant. Each control valve will be provided with a package hydraulic power unit which will include a 1000 psi hydraulic cylinder gate operator, two small high pressure hydraulic pumps, an adequate reservoir, suitable emergency operation accumulators, hydraulic modulating controls, hydraulic piping and fittings and a suitable housing. Use of individual packaged power units minimizes high pressure hydraulic piping and maximizes reliability. Local and remote manual and remote automatic controls and gate position monitoring instrumentation will be included and tied into the centralized control system.

The aerated grit chambers and all aerated channels will be provided with lightweight removable covers and will be positively exhausted through a deodorizing system. Two grit pumps will be provided for each chamber and each will be piped individually to its own separator at the relocated grit and screening hoppers. Pump operation wil normally be timer controlled, but during heavy storm flows will be capable of being operated continuously.

8. Relocation and modification of the existing grit and screening hoppers. Hoppers will be relocated to an area immediately south of and adjacent to the new pump discharge structure. Hopper modifications will include the installation of four grit classifiers, new screenings conveyor discharge equipment and complete enclosures. Each grit classifier will be provided with the discharge of two grit separators and the combinations will be so arranged that the failure of any classifier will not require taking a grit chamber out of service. Separator overflows will be individually directed to the pump discharge structure distribution channel. Housed area will be positively ventilated and all exhaust air deodorized. Convenient truck access to the hoppers will be maintained.

9. Installation of a new aeration system in preaeration portion of sedimentation tanks and the construction of lightweight corrosion-proof covering over the entire turbulent area in each preaeration-sedimentation tank. Positive exhaust ventilation system will include treatment for odor control.

10. Modification of the preaeration-sedimentation tanks to provide better influent distribution, more efficient scum collection, submerged effluent launders and modernization of power and controls. Work on preaeration-sedmentation tanks in building No 2 will also include the installation of more efficient

sludge collection equipment. Influent distribution modification will include the elimination and removal of preaeration-sedimentation inlet control valves and measuring flumes and the installation in their place of a low head loss, aerated distribution channel. The distribution channel will start immediately downstream from the new grit chamber level control valves. Isolating slide gates will be provided at the inlet to each preaeration-sedimentation tank. Aerated distribution channel will be covered with lightweight removable units and exhausted to the grit chamber deodorizing system.

Scum collection revisions will include compressed air skimming and automatic scum removal. Scum removers will be located directly alongside the new sludge pumping stations to reduce the length of collection piping. Sludge collection revisions in the tanks of building No. 2 will include new sludge cross collector channels and new longitudinal collection equipment will be installed similar to that in the other tanks and will be designed to collect sludge from the full length of the tank. All longitudinal collectors will be completely submerged to eliminate interference with the air skimming system.

Submerged effluent launders will be provided with orifices, fabricated of fiberglass and designed to operate in conjunction with new plant effluent control valves. Launder orifices will assure uniform distribution of the sewage flow regardless of the number of tanks in service. Effluent control valves will consist of two hydraulically operated butterfly valves located just downstream from the sedimentation collection channel, complete with individual packaged hydraulic power units and instrumentation and controls capable of maintaining the sedimentation tank water surfaces within plus or minus 1/2-inch of optimum level regardless of flow or downstream water level conditions. Power and controls will be updated to provide sparkless apparatus in those areas exposed to open sewage surfaces, automatic centralized control of the scum and sludge collection equipment, and atmospheric isolation of the sedimentation area power control center.

11. Modification of existing sludge and scum handling and pumping facilities by construction of a new sludge pumping station on the southeast side of sedimentation building No. 2, providing new scum and sludge handling facilities for the sedimentation tanks within building No. 2 and revising the existing scum and sludge handling facilities for the sedimentation tanks within building No. 1. The new sludge pumping station for building No. 2 will be constructed similar to the station already built for building No. 1 and will house the cross-collector drive equipment, scum and sludge pumps and related instruments and controls for the outside tank of building No. 2. Similar equipment for the inside tank of building No. 2 will be housed on the sludge transfer pumping station already built between the two buildings.

All sedimentation cross-collectors will be revised to the screw type designed for variable speed operation with thickening ability. Scum sumps will be located on the side of each sedimentation tank with the pumps directly below in the pumping station. Scum and sludge pumps will be of the progressive cavity, positive displacement type with variable speed drives and will be piped directly via the raw sludge force main to the digesters. Digester circulating sludge will be piped back into each pump station for flushing of scum and raw sludge pumps. All scum and raw sludge piping will be glass lined. Instrumentation and controls will include timers for sludge collector and scum remover control, sludge blanket and density detectors for raw sludge pump control, and liquid level transmitters for scum pump control. All instrumentation signals and controls will be tied into the centralized control system.

12. Relocation of pre and postchlorination injectors and postchlorination diffuser and modification of chlorine handling piping and equipment. Injectors will be relocated to the point of chlorine application to increase the speed of response of the systems. Chlorine will be transported to the injectors in the form of gas under vacuum instead of liquid in solution. Chlorine piping will be modified to transport this gas. The postchlorination diffuser will be relocated to the sedimentation collection channel immediately upstream from the effluent control valves. Head loss turbulence through valves is expected to provide mixing of the chlorine with the effluent.

13. Modification of the existing effluent pumping station to provide additional pumps and piping required to assure the most ef-

ficient addition of dilution water. Two new pumps will be installed to lift bay water from the station's existing bypass chamber and discharge it through a common magnetic flow meter into effluent pump suction channel. Pumps will provide complete standby for each other and each will be capable of lifting up to 36 mgd from the bypass chamber at the lowest low tide. Pumping units will be electric motor driven, variable speed mixed flow pumps.

Dilution pumps will operate continuously and will be controlled to provide one to one dilution for all plant flows up to the point where the effluent suction channel level rises above its optimum operating level, thereby indicating the effluent pumps are up to capacity. If the plant flow continues to increase at this time the speed of the dilution pump will be reduced as required to maintain the optimum operating level in the effluent suction channel. Instrumentation and controls will be automatic and telemetered to the plant centralized control center for monitoring and control.

14. Repair of Islais Creek siphons and submarine section diffusers on the existing outfall so that the effluent can be diluted with salt water as described in item 13.

15. Renovation of the existing No. 3 water system by installing new corrosion resistant screen. No. 3 water will be utilized for chlorine injectors and system pumps will be refitted to provide the pressures and flows required for this service.

16. Renovation of the sludge control building by removing all sludge and scum pumps and installing two permanent steam cleaners. Steam cleaners will provide high pressure (400 psi), high temperature (325°F) water to all critical parts of the sewage treatment areas including the sedimentation buildings, grit chambers, pump discharge structure and headworks building and to all major operation centers in the solids treatment area.

17. Installation of new pipe and conduit tunnels from the existing tunnel near the sludge control building to the new raw sludge pumping station at the sedimentation building No. 2 and the headworks building, from the existing sludge control building to the sludge transfer pumping station, from the existing sludge control building to the raw sludge pumping station at sedimentation building No. 1 and the chlorination building, from the chlorination building to the headworks building, and from each grit pump room to the nearest previously mentioned system. All tunnels will be provided with pile foundations, will be drained, and will be provided with a sufficient number of removable covers to assure ready access for maintenance and repairs. Tunnels will be used for all piping and electric, instrumentation and communication conduits.

18. Installation of new effluent sampling and monitoring devices designed to provide chilled, proportional, composite samples and continuous records of effluent parameters such as D. O., turbidity, pH, temperature, specific conductance and others as required. Data from all monitors will be transmitted to the sewage treatment centralized control center in the headworks building.

In addition to these sewage treatment process improvements the following revisions and modifications should be made to the Southeast plant solids handling and disposal facilities:

19. Cleaning and renovating of digesters 6 and 10 to equal status with existing digesters 8 and 9. This work will include the installation of high energy gas mixing, piping revisions incorporating multiple transfer points and raw and digested sludge mixing, more efficient hot water heat exchangers, and greater capacity circulation pumps in more efficient locations. High energy gas mixing will involve the development of twice the velocity gradient presently found in digesters 8 and 9. All electrical apparatus in the digester control building will be modified for operation in an hazardous area and positive ventilation and exhaust deodorization will be provided. Instrumentation and controls will be tied to the solids treatment control center in the filtration building. Work also includes installation of a hot water circulation system with new low pressure steam boilers. Boilers will be located in the elutriation area of the filtration building.

20. Pumping of digester 8 and 9 contents to digesters 6 and 10 and the modifying of digester 8 and 9 gas mixing to high energy gas mixing.

21. Renovation of the existing sludge filtering system including improvement of the sludge pumping system and expansion and the alteration of the sludge conveyor systems. work will include relocation of the filtering power and control equipment to an isolated atmosphere and incorporating this equipment in a centralized power, control and communica-

tions center for the solids treatment operation of the Southeast plant. One-half of the cost of these modifications is chargeable to the Southeast plant.

22. Renovation of the chemical handling and storage facilities to provide sufficient capacity and more precise control. One-half of the cost of these modifications is chargeable to the Southeast plant.

23. Installation of digester supernatant and vacuum filtrate supplemental treatment facilities. Maximum capacity required for treating Southeast sludge will be 12,000 gallons per hour. The system used will be an electrolytic waste water treatment process which will disinfect, oxidize and improve the clarity of the supernatant and filtrate mixture.

Description of Operation. As indicated in Chapter 2, existing plant improvements are not expected to result in major additional manpower requirements for the Southeast plant. Some operating manpower will be switched to maintenance and the only additional staff will involve two specialized maintenance personnel for electrical and instrumentation repair functions. It is assumed the treatment of the present Southeast wastes utilizes 28 personnel.

The recommended improvements will require additional power even though some reductions will be experienced with the pumping of raw sewage and the elimination of the elutriation of digested solids. Those improvements requiring additional power include the air conditioning, ventilating and deodorizing of the headworks building; additional bar screens, screening conveyors, ventilating and deodorizing of the new pump discharge structure; reactivation of the aeration equipment and an additional grit pump for the existing grit chambers; aeration, collection and pumping equipment for the new grit chambers; agitation air, scum removal, exhaust ventilation and deodorizing equipment for all channels and covered chambers of the existing and new grit chambers; air skimming, additional total pumping head on the sludge and scum pumps and exhaust ventilation and deodorizing of the preaeration sedimentation tanks; increased effluent and new dilution water pumping for the effluent pumping station; increased digester mixing, pumped sludge circulation, ventilation and exhaust deodorization for the digester control buildings; increased hot water pumping, chemical handling, air conditioning, ventilation and exhaust deodorization for the filtration building; and supernatant and filtrate waste treatment. It is expected that 1969-70 power use will increase approximately 1700 horsepower for these improvements. Power use chargeable to the Southeast plant has been assumed to be 56 percent of the total power used at the Southeast plant.

Other utilities are also expected to remain about the same although some minor additional costs may be involved in supplying fuel for the boilers and standby generator. Natural gas use is expected to remain at the 1969-70 level, although some allowance has been made for digester upsets similar to those experienced in January and February of 1971. Gas use chargeable to the Southeast plant has been assumed to be 50 percent of the total gas used at the Southeast plant, the remainder being chargeable to North Point solids treatment.

Influent chlorine use is expected to remain about at the same level as present, which is approximately 2700 lbs/day. If the high chlorine demand of tributary industries are corrected at their source, effluent chlorine use should drop considerably with the removal of the loading of recirculating solids. It is anticipated that effluent chlorine use after the completion of plant improvements and removal of the high industrial waste demands will drop to 15 mg/l, or 4500 lbs/day. It is expected that salt required for odor control facilities will amount to approximately 13,500 lbs/day. Ferric chloride and slaked lime use for filter cake production are expected to average about 1.3 and 8.2 tons per day, respectively.

Normally, it would be expected that maintenance and repair cost would decrease significantly with the construction of the revisions and modifications to the existing plant. The amount presently budgeted is less than normal for plants similar to Southeast and therefore, no reduction in maintenance costs is anticipated. Establishment of a preventive maintenance program will result in some cost reallocations, but, once established, these are expected to remain fairly constant over a long period of time.

Screenings, grit and sludge filter cake disposal costs will increase. Improvements to each of these systems are expected to increase the efficiency of removal with the result that

greater quantities of the material will have to be handled. Screenings are expected to average about 4 cu ft per mil. gal, grit 5 cu ft per mil. gal, and filter cake, prorated on a continuous basis, 130 tons per day. If screenings are 45 percent solids with a specific gravity of 1.0, disposal loadings are expected to average 4.5 tons per day. If grit is 65 percent solids with a specific gravity of 1.5, disposal loadings are expected to average 8.4 tons per day. It is anticipated alternative S1 will require half the existing filters to operate 12 hours per day, 6 days per week.

Estimated Construction Costs. Estimated construction cost, including engineering and contingencies, for improvements to the existing primary plant are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative S1

Sewage Treatment		Solids Treatment	
1.	$ 135,000	19.	$1,225,000
2.	150,000	20.	165,000
3.	960,000	21.	305,000
4.	30,000	22.	50,000
5.	90,000	23.	549,000
6.	480,000	Subtotal	$2,294,000
7.	775,000		
8.	90,000	TOTAL	$7,602,000
9.	150,000		
10.	375,000		
11.	885,000		
12.	45,000		
13.	150,000		
14.	200,000		
15.	45,000		
16.	120,000		
17.	565,000		
18.	63,000		
Subtotal	$5,308,000		

If all work must be completed by 1973, these costs should be increased by approximately 25 percent or $1,900,000.

Estimated Operation Costs. Estimated operating costs for the improved existing plant are based on 1971 prices and are as follows:

	Alternative S1
Labor	$ 486,000
Electric power	140,000
Other utilities (gas, etc)	11,000
Chemicals	227,000
Maintenance, repair and supplies	40,000
Screening and grit disposal	17,000
Other solids disposal	213,000
TOTAL	$1,134,000

Alternative S2A

The only completely physical treatment process which will produce a higher level of effluent and receiving water quality than existing plant improvement involves combining the improvements with dissolved air flotation of the settled sewage. Although additional solids removals are expected with the combined use of primary sedimentation and dissolved air flotation, no major revisions will be required to any other of the sewage or solid treatment facilities except the supernatant and filtrate electolytic waste treatment process. Filter operation will increase to about 14 hours/day, 6 days/week.

Reductions Expected. Upon completion of all the proposed existing plant, effluent pumping and outfall improvements and the installation of dissolved air flotation facilities, it is expected that the following objectives can be attained at the Southeast plant:

Alternative S2A

Parameter	Objectives
Turbidity and color	Less than 30 percent reduction in receiving water clarity.
Floatables	Approximately 20 mg/sq meter floatables in the receiving water.
Grease	Less than 30 mg/l grease in plant effluent.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative S2A, which involves existing plant improvements plus dissolved air flotation, includes the following sewage treatment construction:

1. Construction of improvements to the existing Southeast plant as listed under items 1-18, alternative S1, with the operating head of the effluent pumps increased about 4 feet.

2. Installation of six dissolved air flotation tanks, any five of which will be capable of providing a 2 gpm/sq ft overflow rate at 70 mgd. Each flotation tank inlet will be equipped with a diffusion baffle and a perforated distribution baffle to separate the mixing zone from the flotation zone. Recycled air-charged effluent will be introduced to the settled sewage in the mixing zone at the rate of 40 precent of PSWF, or approximately 4.3 mgd per tank. Pressurizing of the recycle flow will take place in 6 units, one for each tank. Each pressurizing unit will include a recycling pump, a pressurizing tank and all necessary meters and controls. Air for the 6 units will be supplied by three heavy-duty, single stage, water-cooled compressors designed for operation at not less than 60 psi.

Scum removal from the flotation tank surface will be accomplished by mechanical skimmers which will travel the complete length of the tank. No sludge removal equipment will be installed. Scum from each tank will be collected in individual hoppers by helical removers and pumped directly to the raw sludge force main. Scum pumps will be of the progressive cavity, positive displacement type with variable speed drives. Scum piping will be glass lined and will include a flow measuring meter.

Effluent will be removed from the flotation tanks through a series of submerged launders with orifice inlets. The submerged orifices will be designed to provide sufficient head loss to assure the even distribution of the settled sewage regardless of the number of tanks in service. From the launders the effluent will enter a collection channel which will discharge to the effluent sewer by means of two control valves. Each dissolved flotation control valve will be of the modulating type designed to maintain the optimum operating level in the flotation tanks within plus or minus one-half inch from minimum flow to the peak hydraulic capacity of the plant regardless of downstream water level conditions. Control valves will be hydraulically operated butterfly valves, each complete with individual packaged hydraulic power unit and necessary instrumentation and controls.

The dissolved air flotation system will be housed in a separate structure and will be provided with positive supply and exhaust ventilation system. Deodorizing facilities will be provided for all ventilation exhaust. Power, controls and instrumentation will be connected to the centralized control system.

In addition to these sewage treatment process improvements the following plant improvements should be made to the solids treatment and disposal facilities at the Southeast plant:

3. Construction of improvements to the existing Southeast plant as listed under items 19-23, alternative S1, with the electrolytic wastewater treatment process for digester supernatant and vacuum filter filtrate increased in capacity to 13,000 gal/hr.

Description of Operation. The operation of the existing plant improvements and dissolved air flotation treatment process as described for alternative S2A is expected to require two additional personnel beyond those required for alternative S1. It is anticipated that these will be utilized as maintenance operators to provide preventive maintenance for the additional equipment and structures involved in this alternative.

In addition to the extra horsepower required by the existing plant improvements of alternative S1, alternative S2A will require additional horsepower for recycling of 40 percent of the flow; air compressing; scum skimming, removal and pumping; flotation control valves; and ventilation and deodorizing of the dissolved air flotation system; extra effluent pumping head; and larger electrolytic treatment facilities. It is expected that 1969-70 power use will increase approximately 2400 horsepower for this alternative. Other utilities, including natural gas, are expected to remain the same as determined for alternative S1.

No change is anticipated in the use of chlorine between alternative S1 and S2A. Salt required for odor control facilities is expected to increase to approximately 17,200 lbs per day, while ferric chloride and slaked lime use for filter cake production are expected to increase to 1.6 and 9.8 tons per day, respectively. Changes in maintenance and repair costs between alternatives S1 and S2A are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives S1 and S2A. It is anticipated that alternative S2A will require half the existing filters to be operated 14 hrs per day, six days per week. Filter cake production, when prorated to a continuous basis, will average 158 tons per day.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative S2A which provides for improved treatment efficiency through use of dissolved air flotation plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative S2A

Sewage Treatment		Solids Treatment	
1.	$ 5,308,000	3.	$ 2,335,000
2.	3,250,000	Subtotal	$ 2,335,000
Subtotal	$8,458,000	TOTAL	$10,793,000

The costs above do not include any allowance for purchase of land required for dissolved air flotation structures. If all work must be completed by 1973, these costs should be increased by approximately 25 percent or $2,700,000.

Estimated Operating Costs. Estimated operating costs for the improved existing plant and dissolved air flotation are based on 1971 prices and are as follows:

	Alternative S2A
Labor	$ 519,000
Electric power	185,000
Other utilities (gas, etc)	11,000
Chemicals	261,000
Maintenance, repairs and supplies	58,000
Screening and grit disposal	17,000
Other solids disposal	260,000
TOTAL	$1,311,000

Alternative S2B

The least expensive capital cost alternative which will produce a level of effluent and receiving water quality higher than that produced by alternative S1 involves combining alternative S1 improvements with low dose ferric chloride chemical treatment. Low dose ferric chlorine treatment involves addition of 15-45 mg/l ferric chloride together with salt water and polymer to the raw sewage just prior to its passing though the grit chamber control valves and flocculation of this mixture in the preaeration portion of the sedimentation tanks. Although the solids from the sedimentation tanks are expected to average 3.5 percent and increase in volume, it is anticipated that the improved digester capacity will be able to assimilate the additional load. Because of the difficulty of dewatering digested sludge containing a large percentage of ferric chloride floc, heat conditioning of the sludge prior to filtering is proposed. The heat conditioning process is described under alternative N2 for the North Point plant. Electrolytic waste water treatment will be utilized to treat the digester supernatant, heat conditioning decant, and vacuum filter filtrate.

Reductions Expected. Upon completion of all the proposed existing plant, effluent pumping and outfall improvements and the installation of low dose ferric chloride chemical process improvements, it is expected that the following objectives can be attained at the Southeast plant.

Alternative S2B

Parameter	Objectives
Turbidity and color	Approximately 20 percent reduction in receiving water.
Floatables	Approximately 20 mg/square meter floatables in the receiving waters.
Grease	Greater than 30 mg/l grease in plant effluent
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative S2B, which involves existing plant improvements plus the low dose ferric chloride chemical process, includes the following sewage treatment construction:

1. Construction of improvements to the existing Southeast plant as listed under items 1-18, alternative S1.
2. Installation of chemical storage and feeding facilities, including chemical metering pumps, fiberglass chemical storage tanks, and automatic controls. It is anticipated that the ferric chloride will be supplied, stored and fed in the liquid form.
3. Installation of salt water pumping facility designed to maintain 1200-1500 mg/l NaCl level in the plant influent. Permanent installation will consist of at least two variable speed pumps, each capable of pumping up to 5.5 mgd of bay water. Pumps will be located at the effluent pumping station and will discharge into the nearest tributary sanitary sewer. Automatic controls will be telemetered to the sewage treatment plant's centralized control center.
4. Installation of storage and feeding facilities for applying 0.25 mg/l of polymer.

In addition to these sewage treatment process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Southeast plant:

5. Construction of improvements to the existing Southeast plant as listed under items 19-21 and 23, alternative S1, with the electrolytic waste water treatment process for digester supernatant, heat conditioning decant and filtrate increased in capacity to 25,000 gallons per hour.
6. Installation of sludge heat conditioning facilities including solids disintegration, heat exchangers, pumps, control valves, reactor vessels, treated sludge storage and decanting tanks, pressure ventilation and deodorization, and necessary controls. Facilities will have a capacity of 19,000 gallons per hour.

Description of Operation. The chemical treatment process proposed under alternative S2B will require little additional manpower. It is anticipated the requirements of the additional chemical handling equipment and solids heat conditioning treatment will add no more than two personnel in addition to those required under alternative S1.

Alternative S2B will require more power than alternative S1, because of the pumping of approximately ten percent of the flow as salt water from the bay, heat conditioning treatment, and additional electrolytic treatment for supernatant, decant and filtrate wastes. It is estimated the extra power over 1969-70 use will involve the continuous running ot approximately 2600 horsepower. As long as the digesters stay reasonably healthy, no change is expected on the demands for the other utilities.

Chlorine use under alternative S2B will remain the same as alternative S1. Salt required for odor control facilities is expected to increase to 15,000 lbs/day. Approximately 4.5 tons per day of ferric chloride and 50 lbs per day of organic polymer will be required to provide the necessary chemical treatment. No chemicals will be required for filter cake production. Changes in maintenance and repair costs between alternatives S1 and S2B are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternatives S1 and S2B. It is expected that alternative S2B will require half of the existing filters to be operated 8 hours per day, 6 days per week. Filter cake is expected to average, on a prorated continuous basis, approximately 86.5 tons per day. The lower filter cake volume reflects both the production of a dryer cake and the absence of filter assisting chemicals.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative S2B which provides for improved treatment efficiency through the use of low dose ferric chloride chemical treatment plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative S2B

Sewage Treatment		Solids Treatment	
1.	$ 5,308,000	5.	$ 2,760,000
2.	95,000	6.	2,250,000
3.	20,000	Subtotal	$ 5,010,000
4.	15,000	TOTAL	$10,448,000
Subtotal	$ 5,438,000		

If all work must be completed by 1973, these costs should be increased by approximately 25 percent or $2,500,000.

Estimated Operating Costs. Estimated annual operating costs for the improved existing plant and low dose ferric chloride chemical treatment are based on 1971 prices and are as follows:

	Alternative S2B
Labor	$ 519,000
Electric power	199,000
Other Utilities (gas, etc)	11,000
Chemicals	299,000
Maintenance, repairs and supplies	53,000
Screening and grit disposal	17,000
Other solids disposal	142,000
TOTAL	$1,240,000

Alternative S3

The most compact biological treatment process which will produce a level of effluent and receiving water quality capable of meeting the most stringent requirements of the Regional Board at the Southeast plant. except the one for effluent grease, involves combining the existing plant improvements with activated sludge biological treatment. Activated sludge biological treatment involves the mixing of settled sewage in aerobic tanks with return sludge from the secondary sedimentation tanks and the settling of the mixed liquor solids in secondary sedimentation tanks. Aeration tanks will operate on loadings up to 50 lbs applied BOD/1000 cu ft/day. Return sludge reaeration facilities will be provided. Secondary sedimentation tanks will have an overflow rate of 2000 gal/sq ft/day for PWWF. Flotation type thickeners for the waste activated sludge will be designed for loadings of 20 lbs/sq ft/day. The successful operation of this alternative will depend to a large degree on enforcement of the City's industrial waste controls.

Reductions Expected. With the completion of all the proposed existing plant effluent pumping and outfall improvements and the installation of biological activated sludge treatment facilities, it is expected that the following objectives can be attained at the Southeast plant:

Alternative S3

Parameter	Objectives
Turbidity and color	Less than 5 percent reduction in receiving waters clarity.
Floatables	Less than 10 mg/square meter floatables in the receiving waters.
Grease	Effluent concentration of approximately 10 mg/l.
Settleable matter	Compliance will all objectives.

Description of Construction. Alternative S3, which involves existing plant improvements plus the activated sludge biological process, includes the following sewage treatment construction:

1. Construction of improvements to the existing Southeast plant as listed under items 1-18, alternative S1, with the operating head of the effluent pumps increased about 4 ft.

2. Installation of an activated sludge biological treatment system complete with aeration and secondary sedimentation facilities.

Aeration facilities will include two rectangular-reinforced concrete tanks each of which is expected to be approximately 270 feet long, 125 feet wide and 15 feet deep, and will be divided by intermediate curtain walls into four passes. Each aeration tank will have a hydraulic capacity of 35 mgd.

Diffused air will be supplied by retractable air diffuser assemblies through coarse bubble diffusers to the bottom of the tank. Retractable assemblies will permit maintenance and cleaning on the diffusers without taking the tanks out of service and will be mounted on the tank struts. Assemblies will be arranged to locate the diffusers to provide agitation and diffusion in a manner which will eliminate the possibility of flow short circuiting through the tanks. Main air headers supplying the retractable assemblies will be installed at the top of alternate tank passes and valves and meters will be provided on each lateral to enable adjustment of air rate automatically in relationship to the dissolved oxygen level in the tank pass. Polargraphic DO probes will be provided to monitor each tank pass. Adequate tank drains will be provided.

Aerated settled sewage channels around three sides of the two tanks will permit incremental addition of settled sewage to each pass of each tank. The settled sewage channel at the effluent end of the aeration tank will be paralleled by mixed liquor and return activated sludge channels and by an equipment gallery which will contain air headers, aeration and agitation air blowers, return sludge pumps, and other related equipment. Settled sewage, mixed liquor and return sludge channels will be designed for minimum velocities to reduce hydraulic losses. All channels will be aerated to prevent deposition of solids. Diffusers for channel agitation will be mounted on removable assemblies which will permit maintenance and cleaning of the diffusers without taking the channels out of service.

Water sprays will be installed in each pass of each aerated channel to supress foam. The sprays will use low pressure No. 3 water to which a suppressing chemical may be added as required.

Aeration air will be provided by thirteen electric motor driven, multi-stage centrifugal blowers located in the equipment gallery of the aeration tank. Any twelve blowers will be capable of supplying aeration air at the rate of 1200 cu ft per lb of BOD removed. Aeration blower output will be regulated by throttling the blower inlet to maintain a set operating pressure in the supply air header. Oil wetted intake air filters will be provided to remove any air particles which might damage the blowers or clog the coarse bubble diffusers. Automatic external bypasses will be provided on each blower to protect against surging during start-up and excessive throttling.

Settled sewage and return activated sludge distribution to the aeration tanks will be controlled hydraulically to provide proportional or uniform applications as required. Mixed liquor will be discharged from the aeration tanks over weirs of sufficient length to minimize variations in aeration tank water surface elevations.

Secondary sedimentation will take place in four circular reinforced concrete tanks. Each tank will have a diameter of 120 feet and a side water depth of 20 feet. Any three tanks will be able to handle the PWWF with an overflow rate of 2000 gal per sq ft per day. The tanks will be arranged in a single battery of four fed from the aeration mixed liquor channel by a single center channel.

Mixed liquor will be introduced at the center of the secondary sedimentation tanks through a baffling structure, and effluent will be collected by orifices mounted in double concentric submerged launders arranged to provide maximum solids removal efficiency. Sludge will be continuously removed by a rotating hollow tube fitted with orifices and a squeegee. The rate of sludge removal will be automatically controlled to maintain a preset sludge blanket level. Sludge will be withdrawn by low lift propeller pumps with variable speed drives located in the equipment gallery of the aeration structure, metered and then discharged to the return activated sludge channel. Convenient means will be provided for sampling and visual observation of the return activated sludge and mixed liquor. Excess activated sludge or mixed liquor will be wasted by means of variable speed, progressive cavity, positive displacement pumps to the flotation thickeners.

Automatic skimming will be provided on each secondary sedimentation tank with the scum removed directly to ejectors for discharge to the raw sludge force main. Effluent collection orifices will be designed to provide sufficient head loss to assure even distribution of the mixed liquor regardless of the number of tanks in service. Effluent from the submerged launders will enter a collection channel which will discharge to the effluent sewer by means of two control valves. Each secondary sedimentation control valve will be of the modulating type designed to maintain the optimum operating level in the tanks within plus or minus 1/21/2-inch from minimum flow to the peak hydraulic capacity of the plant regardless of downstream water level conditions. Control valves will consist of hydraulically operated butterfly valves, each complete with individual packaged hydraulic power unit and necessary instrumentation and controls.

The activated sludge biological treatment facilities will be uncovered except for the return activated sludge collection and distribution channel. This will be covered by lightweight, corrosion resistant aluminum panels. The air from under the covers will be exhausted through the aeration blowers to the mixed liquor in the aeration tanks. All instrumentation and controls will be transmitted to the centralized control center.

In addition to these sewage treatment

process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Southeast plant:

3. Installation of at least two air flotation thickening units to provide 1800 sq ft of tank surface including adequate stand-by. Each tank will be provided with top scum and bottom sludge collection and removal equipment, settled sewage and compressed air dissolving equipment, and automatic controls. Tanks will be housed and provided with positive ventilation and odor control equipment. Thickener overflow will be pumped to the raw sewage pump discharge structure.

4. Construction of improvements to the existing Southeast plant as listed under items 19-23, alternative S1, with the electrolytic wastewater treatment process for digester supernatant and filtrate designed for a maximum capacity of 13,000 gph.

Description of Operation. The activated sludge biological treatment process with existing plant improvements proposed under alternative S3 will require more manpower than the other alternatives providing lesser treatment. It is anticipated that biological treatment facilities and the related flotation thickening facilities will require the equivalent of one full time maintenance operator in addition to the other personnel required for alternative S1. With continuous duty, this maintenance operator position alone will entail the addition of at least five new personnel.

More power will be required for operation under alternative S3 than under S1. Extra power use will result from the aeration and agitation air blowers, the return activated sludge pumps, the secondary sedimentation tank drives, the flotation thickener pumps, compressors and ventilation and deodorizing equipment, the larger electrolytic facilities, and the extra head on the effluent pumps. It is expected that 1969-70 power use will increase approximately 4200 horsepower for these improvements. Other utilities, including natural gas, are expected to remain the same as determined for alternative S1.

Chlorine requirements for disinfection are expected to be appreciably less than for alternatives providing a lesser degree of treatment. Chlorine use for disinfection is expected to be reduced to about 8 mg/l, or about 2400 lbs per day. Influent chlorination usage is expected to remain the same as alternative S1. Salt use will increase to approximately 15,000 lbs per day. Ferric chloride and slaked lime use for filter cake will increase to an average of 1.6 and 9.8 tons per day, respectively. Changes in maintenance and repair costs between alternative S1 and S3 are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal cost will remain unchanged between alternatives S1 and S3. It is anticipated that alternative S3 will require half of the existing filters to be operated approximately 14 hours per day, six days per week. Filter cake production, when prorated to a continuous basis, will average 157 tons per day.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative S3 which provides for improved treatment efficiency through use of activated sludge biological treatment plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices.

Alternative S3

Sewage Treatment		Solids Treatment	
1.	\$ 5,308,000	3.	\$ 600,000
2.	10,650,000	4.	2,300,000
Subtotal	\$15,958,000	Subtotal	\$ 2,900,000
		TOTAL	\$18,858,000

The costs above do not include any allowance for purchase of land required for structures for biological treatment. If all work must be completed by 1975, these costs should be increased by approximately 25 percent or \$6,700,000.

Estimated Operating Costs. Estimated annual operating costs for the improved existing plant and activated sludge biological treatment are based on 1971 prices and are as follows:

Alternative S3

Labor	$ 567,000
Electric power	304,000
Other utilities (gas, etc)	11,000
Chemicals	229,000
Maintenance, repairs and supplies	99,000
Screenings and grit disposal	17,000
Other solids disposal	258,000
TOTAL	$1,485,000

Alternative S4A

The lowest first cost alternative which will produce a level of effluent and receiving water quality meeting all the most stringent requirements of the Regional Board at the Southeast plant involves combining the existing plant improvements with high dose lime chemical treatment and solids incineration. High dose lime chemical treatment involves dosage of the screened sewage prior to preaeration and sedimentation with 450 to 550 mg/l of slaked lime, recycling of up to 25 percent of the ADWF through the preaeration flocculator, and recarbonation of the effluent prior to postchlorination, Solids produced will be increased substantially over other alternatives and major alterations to the sludge handling and disposal facilities will be required. The high magnesium content of Southeast raw sewage results in large quantities of soluble calcium being lost in the effluent as well as the generation of large quantities of magnesium hydroxide precipitate. These effects reduce the calcium oxide fraction of the recalcined product as well as the total amount of CaO which can be recovered. As a result no attempt has been made to provide for recalcining even though the immediate use is available. Solids handling and disposal for this alternative consists therefore, of thickening, filtering and incineration. Improved facilities for sedimentation solids removal and disposal will be designed to allow for the recirculation of the preaeration underflow.

Reductions Expected. With the completion of all the proposed existing plant, effluent pumping and outfall improvements and the installation of high dose lime chemical treatment, it is expected that the following objectives can be attained at the Southeast plant:

Alternative S4A

Parameter	Objectives
Turbidity and color	Less than 5 percent reduction in receiving waters clarity.
Floatables	Less than 10 mg/sq meter floatables in the receiving waters.
Grease	Less than 5 mg/l in plant effluent
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative S4A, which involves existing plant improvements and high dose lime chemical treatment, includes the following sewage treatment construction:

1. Construction of improvements to the existing Southeast plant as listed under items 1-18, alternative S 1.

2. Installation of chemical storage and feeding facilities, including storage hoppers, a conveying system, weighing hoppers, slaker feeders, and automatic controls. It is anticipated that two overhead hoppers will provide a combined storage capacity of 300 cubic yards of calcium oxide and will be equipped with vibrators and distributors to insure full utilization of available volume. Lime will be transferred pneumatically from bulk delivery trucks or railroad cars to the hoppers. From the hoppers, the calcium oxide will be conveyed to weighing hoppers located directly over the slakers. The slakers will incorporate gravimetric type feeders and will be located directly over the collection channel immediately upstream from the grit chamber control valves. Immediately after lime addition, the flow will be rapidly mixed hydraulically as it passes through the head dissipating control valves. All calcium oxide handling facilities will be designed for dust free operation with minimum maintenance and a peak feeding rate of 4.6 tons per hour.

3. Installation of preaeration flocculator recycling facilities capable of recirculating up to 9 mgd of 5 percent underflow through the lime mixing and flocculation system. The eight pumps will be variable speed and sytem controls will be designed to maintain a one percent level of lime sludge slurry in the preaeration reactor.

4. Installation of recarbonation facilities including fiberglass carbon dioxide storage tanks and equipment and apparatus required to introduce gaseous CO_2 to the flow immediately upstream from the sedimentation effluent control valves. The recarbonation system will be capable of lowering the effluent pH to 7.3. Carbon dioxide capacity will be at least 18 tons per day with 48 tons chilled storage capacity. Carbon dioxide will be diffused into the flow by ten stainless steel mixing diffusers designed to assure maximum assimilation. 1560 sq ft of contact chamber area with approximately 4 minutes of retention at PWWF will be provided. Liquid Co_2 will be delivered by truck or railroad tanker.

In addition to these sewage treatment process improvements the following plant improvements should be made to the solids treatment and disposal facilities at the Southeast plant:

5. Construction of 7800 sq ft of gravity thickening facilities with adequate stand-by. Thickening facilities will include automatic sludge and scum removal and pumping equipment, overflow and disposal piping, and instrumentation control tied to the Southeast solids treatment centralized control center in the filtration building.

6. Utilization of digesters 8 and 9 as raw sludge holding tanks. To provide full utilization, high energy gas mixers will be installed as recommended in item 20, alternative S1.

7. Renovation of existing sludge filtering system as recommended for item 21, alternative S1, plus installation of one additional 11.5 x 16 ft vacuum filter with necessary additional supporting structure and equipment. It is expected half of the existing filters plus the new filter will be able to handle the plant load by operating approximately 22 hours per day, 6 days a week.

8. Installation of vacuum filter filtrate electrolytic treatment facilities for 10,000 gph maximum flow.

9. Installation of two 143.5 dry tons per day, 22.25 ft dia, 9 hearth incinerators. Incinerators will include necessary equipment to handle screenings and grit from the Southeast plant, access platforms, instrumentation and controls, and stack scrubbers and afterburners, and will maintain a plumeless stack discharge complying with all present air pollution regulations. Ash storage and loading facilities are also included. The two incinerators will provide complete stand-by capacity. Instrumentation and controls will be tied to the solids treatment centralized control center in the filtration building.

Description of Operation. The chemical treatment process and solids disposal system proposed under alternative S4A will require more manpower than any of the other alternatives. It is anticipated the calcium oxide handling and mixing facilities, the recarbonation facilities, and the solids thickening, filtering and incinerating facilities will require the equivalent of three full-time maintenance operators in addition to the other personnel required for alternative S1. With continuous duty, these maintenance operator positions will entail the addition of at least 15 new personnel.

More power will be required for operation under alternative S4A than under S1. Extra power use will result from the chemical handling facilities, preaeration underflow recycling, carbon dioxide diffusion, additional solids filtering and the incineration process. If the preaeration underflow recycling averages 10 percent of the plant flow, it is estimated the extra power requirements above 1969-70 use will approximate 2000 horsepower on a continuous basis. Other utility costs are expected to remain about the same as for alternative S1, except for the use of 3500 Therms/day of natural gas by the incinerator.

Influent and effluent chlorine use under alternative S4 A will remain the same as alternative S3. Salt requirements for odor control will drop to approximately 6000 lbs per day because control systems will no longer be required for the preaeration area of the sedimentation tanks, the digester control building or the filtration building. It is estimated that alternative S4A will require 57 tons per day of calcium oxide and about 9.2 tons per day of carbon dioxide.

Changes in maintenance and repair costs between alternatives S1 and S4A are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will be reduced under alternative S4A by providing capacity in the incinerator to burn them to ash with the sludge filter cake. Screenings and

grit are expected to provide an average additional incineration load of approximately 12.9 tons per day of wet solids. The incinerator system is expected to produce an average of approxiamtely 125 tons per day of damp ash (20 percent moisture) to be hauled to land fill disposal.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative S4A which provides for improved treatment efficiency through use of high dose lime chemical treatment plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices:

Alternative S4A

Sewage Treatment		Solids Treatment	
1.	$ 5,308,000	5.	$ 1,200,000
2.	165,000	6.	165,000
3.	90,000	7.	1,020,000
4.	585,000	8.	465,000
Subtotal	$ 6,148,000	9.	4,545,000
		Subtotal	$ 7,395,000
		TOTAL	$13,543,000

The costs above do not include any allowance for purchase of land required for incineration structures. If all work must be completed by 1975, these costs should be increased by approximately 25 percent or $3,400,000.

Estimated Operating Costs. Estimated annual costs for the improved existing plant and high dose lime chemical treatment with incineration are based on 1971 prices and are as follows:

	Alternative S4A
Labor	$ 729,000
Electric power	160,000
Other utilities (gas, etc)	100,000
Chemicals	744,000
Maintenance, repairs and supplies	73,000
Screening and grit disposal	3,000
Other solids disposal	205,000
TOTAL	$2,014,000

Alternative S4B

The lowest operation cost alternative which will produce a level of effluent and receiving water quality meeting all the most stringent requirements of the Regional Board at the Southeast plant involves combining existing plant improvements with high dose ferric chloride chemical treatment followed by dual media filtration with effluent pumping. High dose ferric chloride chemical treatment involves the dosage of the raw sewage prior to its passage through the grit chamber control valves with 100-150 mg/l of ferric chloride, salt water and polymer.

Chemical treatment of this type will cause additional solids to be removed and more solids to be handled and disposed of by the Southeast plant solids treatment system. To assure proper solids thickening of the lighter ferric chloride floc, flotation type thickeners loaded at 20 lbs/sq ft/day are recommended and the percent solids content of the thickened sludge held to 4. Both of these figures materially affect the solids handling system by increasing thickening system costs and increasing the supernatant treatment requirements.

To maintain relatively low filtering costs and assure the use of the existing filtering system without expensive enlargements, sludge heat conditioning similar to that described for alternative S2B is proposed for this alternative. It is expected that the heat conditioned digested solids will filter without chemical addition at the rate of 10 lbs/sq ft/day. The digester supernatant, heat conditioning decant, and vacuum filter filtrate will be treated by the electrolytic wastewater treatment process.

Reductions Expected. With completion of all the proposed existing plant, effluent pumping and outfall improvements and the installation of high dose ferric chloride chemical treatment followed by filtration, it is expected that the following objectives can be attained at the Southeast plant:

Alternative S4B

Parameter	Objectives
Turbidity and color	Less than 5 percent reduction in receiving waters clarity.
Floatables	Less than 10 mg/sq meter floatables in the receiving waters.
Grease	Less than 5 mg/l in plant effluent.
Settleable matter	Compliance with all objectives.

Description of Construction. Alternative S4B, which involves existing plant improvements and high dose ferric chloride chemical treatment followed by filtration, includes the following sewage treatment construction:

1. Construction of improvements to the existing Southeast plant as listed under items 1-8, 10, 11, 13-18 under alternative S1, with the operating head of the effluent pumps increased about 10 ft.

Installation of chemical storage and feed facilities, including chemical metering pumps, two fiberglass chemical storage tanks and automatic controls. It is anticipated that the ferric chloride will be supplied, stored and fed in the liquid form. The chemical metering pumps will have a peak capacity of 44 tons per day with adequate stand-by and the storage tanks will have a total capacity for about 96 tons.

3. Installation of salt water pumping facility as recommended in item 3, alternative S2B.

4. Installation of storage and feeding facilities for applying 0.5 mg/l of polymer 24 hr/day. Feeding facilities will have a peak capacity of 200 lbs per day with adequate stand-by and storage facilities will have the capacity for about 800 lbs.

5. Installation of mechanical flocculating equipment in the existing preaeration tanks. Flocculators will be installed to operate in the reverse direction 10 minutes of every hour. They will be installed above the existing collection equipment which will remain in place and in operation. Flocculator impellers will be designed to de-rag when operated in reverse.

6. Installation of ten bifurcated dual-media filters each of which will have 900 sq ft of surface area. The filtration system will be installed downstream from the sedimentation hydraulic level control valves and will include air-water backwash facilities and automatic head loss and backwash controls. Backwash water will be provided by two pumps, each capable of providing one-half of a filter with 13 mgd of filter effluent. It is anticipated that backwashings will be discharged into the raw sewage flow immediately upstream from the raw sewage pumps. Any 9 filters will be capable of handling the peak wet weather flow.

7. Relocation of prechlorination injector and modification of influent and effluent chlorine handling piping and equipment as recommended under item 12, alternative S1 and the relocation of the postchlorination injector and new mixer diffuser to a point immediately downstream from the dual-media filters. Motor driven mixers will assure the thorough mixing of the effluent and chlorine.

8. Relocation and relaying of approximately 2500 ft of pile supported 72-inch sewer between the dual-media filter and the existing effluent pumping station. Head losses in the filters are such that the existing sewer cannot be used.

In addition to these sewage treatment process improvements, the following plant improvements should be made to the solids treatment and disposal facilities at the Southeasy plant:

9. Construction of 7000 sq ft of air flotation thickening facilities with adequate stand-by. Each flotation tank will be provided with top scum and bottom sludge collection and removal equipment, and automatic controls. Tanks will be housed and provided with positive ventilation and odor control equipment. Thickener overflow will be pumped to the raw sewage discharge structure. Automatic controls and instrumentation will be tied to the solids treatment centralized control center in the filtration building.

10. Construction of improvements to the existing Southeast plant as listed under items 19-21 and 23, alternative S1, with the electrolytic waste treatment process for digester supernatant, heat conditioning decant and filtrate increased in capacity to 30,000 gph.

11. Pumping of digester 7 contents to other digesters, modifying piping to incorporate multiple transfer points similar to other digesters, and modifying existing gas mixing system to high energy mixing.

12. Installation of sludge conditioning facilities including solids disintegration, heat exchangers, pumps, control valves, reactor vessels, treated sludge storage and decanting tank, pressure ventilation and deodorization, and necessary controls. Facilities will have a capacity of 26,500 gph.

Description of Operations. The chemical treatment process with filtration proposed under alternative S4B will require more manpower than the alternatives providing lesser treatment. It is anticipated the ferric chloride handling and flocculating equipment, the filters and appurtenances, air flotation thickeners and heat conditioning facilities will require the equivalent of two full-time maintenance operators in addition to the other personnel required for alternative S1. With continuous duty, these maintenance operator positions will entail the addition of at least 10 new personnel.

More power will be required for operation under alternative S4B than under S1. Extra power use will result from the chemical handling, mechanical flocculation, filter backwash, additional digester operation, heat conditioning, additional filtering, additional ventilation and deodorizing equipment, additional electrolytic waste treatment, and the extra head on the effluent pumps. It is expected that 1969-70 power use will increase approximately 3000 horsepower for these improvements. Other utilities, including natural gas, are expected to remain the same as determined for alternative S1.

Influent and effluent chlorine use under alternative S4B will remain the same as alternative S3. Salt requirements for odor control will remain at approximately 13,500 lbs per day. It is estimated alternative S4B will require 18.7 tons per day of ferric chloride and about 150 lbs per day of polymer.

Changes in maintenance and repair costs between alternatives S1 and S4B are expected to parallel the increased investment in equipment and facilities.

Screening and grit disposal costs will remain unchanged between alternative S1 and S4B. It is anticipated that alternative S4B will require half of the existing filters to be operated 12 hrs per day, six days per week. Filter cake production, when prorated to a continuous basis, will average 130 tons per day.

Estimated Construction Costs. Estimated construction costs, including engineering and contingencies, for alternative S4B which provides for improved treatment efficiency through use of high dose ferric chloride chemical treatment with filtration plus existing plant improvements are presented below. Costs are given for each item discussed in the preceding section and are based on 1971 prices:

Alternative S4B

Sewage Treatment		Solids Treatment	
1.	$ 5,113,000	9.	$ 2,055,000
2.	285,000	10.	2,958,000
3.	20,000	11.	115,000
4.	30,000	12.	3,075,000
5.	180,000		
6.	6,270,000	Subtotal	$ 8,203,000
7.	60,000	TOTAL	$20,986,000
8.	825,000		
Subtotal	$12,783,000		

The costs above do not include any allowance for purchase of land required for dual-media filter structures. If all work must be completed by 1975, these costs should be increased by approximately 25 percent or $5,000,000.

Estimated Operating Costs. Estimated annual operating costs for the improved existing plant and high dose ferric chloride treatment plus filtration are based on 1971 prices and are as follows:

	Alternative S4B
Labor	$ 648,000
Electric power	225,000
Other utilities (gas, etc)	11,000
Chemicals	723,000
Maintenance, repairs and supplies	110,000
Screenings and grit disposal	17,000
Other solids disposal	213,000
TOTAL	$1,947,000

Summary

Table 6-5 presents the predicted plant performance for each of the alternatives proposed for the Southeast plant. Table 6-6 summarizes estimated construction and operating costs of the alternatives.

Table 6-5

Predicted Performance of Alternative Treatment Processes, Southeast Water Pollution Control Plant

Alternative	Percent reduction in receiving water clarity	Floatable concentration in receiving water, mg/sq meter	Grease concentration in effluent, mg/l	Settleable matter in effluent, ml/l		
				a	b	c
S1	< 30[d]	25[d]	> 30	< 1.0[e]	< 0.5[e]	> 0.4
S2A	< 30[d]	20[d]	< 30[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
S2B	20[d]	20[d]	> 30	< 1.0[e]	< 0.5[e]	< 0.4[e]
S3	< 5[e]	< 10[e]	10-15[d]	< 1.0[e]	< 0.5[e]	< 0.4[e]
S4A	< 5[e]	< 10[e]	< 5[e]	< 1.0[e]	< 0.5[e]	< 0.4[e]
S4B	< 5[e]	< 10[e]	< 5[e]	< 1.0[e]	< 0.5[e]	< 0.4[e]

[a] Maximum in any one sample.

[b] Arithmetic average of any six or more samples collected on any day.

[c] 80 percent of all individual samples collected during maximum daily flow over any 30-day period.

[d] Meets minimum stipulated objective.

[e] Meets maximum stipulated objective.

Table 6-6

Estimated Construction and Operating Costs of Alternative Treatment Processes, Southeast Water Pollution Control Plant

Alternative	Estimated construction cost, dollars[a]	Estimated annual operating cost, dollars
S1	7,602,000	1,134,000
S2A	10,793,000	1,311,000
S2B	10,448,000	1,240,000
S3	18,858,000	1,485,000
S4A	13,543,000	2,014,000
S4B	20,986,000	1,947,000

[a] No land costs included. See appendix E3 for additional area required for each alternative.

APPENDIX A

ALTERNATIVE TREATMENT PROCESSES

SOLIDS HANDLING BALANCES

APPENDIX A

ALTERNATIVE TREATMENT PROCESSES

SOLIDS HANDLING BALANCES

Although the basic objective of this study is to develop alternative treatment processes to attain various levels of effluent quality, analyses of sludge production and of sludge treatment and disposal had to be made for each alternative to develop cost data which can be used to evaluate the alternatives. Facilities required for solids treatment and disposal for the North Point and Southeast plants were determined independently even though all solids from both plants are to be handled and disposed of at the Southeast plant. Undoubtedly, certain economies could be realized if the sewage treatment process for each plant required similar solids treatment and disposal facilities. For example, if both plants were to utilize the high lime dose alternative with incineration (N4A and S4A), it is estimated only 3 incinerators would be required to treat the combined solids of both plants. This is a reduction of 2 incinerators below the number required based on separate analyses for the two plants. The reduced number of incinerators would result in a construction cost approximately $2,500,000 less than that developed by the separate analyses. Other cost reductions would occur in thickening, filtering and filtrate treatment facilities. Because we are unable at this time to determine whether alternatives requiring similar sludge treatment and disposal facilities will be utilized, it is impossible to estimate the probable amount of such reductions.

SEWAGE TREATMENT SOLIDS PRODUCTION

The quantities of solids produced by each alternative sewage treatment process at each plant were calculated on the basis of process relationships (kinetics, stoichiometry, etc.) that were developed in the plant operation study and pilot plant studies, or were available in the literature. Grit and screenings generation rates will be the same under all alternatives and are summarized in Table A-1 for all three plants.

North Point Water Pollution Control Plant

The quantities of solids produced at the North Point plant will increase above the present levels for all alternatives because of the process improvements and changes. For the purposes of these comparisons ADWF and TSS for the North Point plant are assumed to be 71 mgd and 194 mg/l, respectively.

Alternative N1. Under this alternative, 65 percent suspended solids removal during ADWF will result in the generation of 75,000 lbs (dry) per day of primary solids concentrations of sludge pumped to the Southeast plant will be about 1.1 percent.

Alternative N2. Under this alternative, it is expected that suspended

TABLE A-1

GRIT AND SCREENINGS

PRODUCTION RATES

Plant	Plant sewage flow, mgd	Type	Total solids, percent	Volatile matter percent	Rate (wet) lbs/day
North Point	71	Grit[a]	65	70	34,000
		Screenings[b]	45	90	16,000
Richmond-Sunset	28	Grit[a]	65	70	13,000
		Screenings[b]	45	90	7,000
Southeast	36	Grit[a]	65	70	16,800
		Screenings[b]	45	90	9,000

[a] Specific gravity assumed 1.5.

[b] Specific gravity assumed 1.0.

solids removal will increase to 75 percent (86,000 lbs (dry) per day). In addition, it is expected ferric chloride dosage of 30 mg/l will produce 14,000 lbs (dry) per day of chemical sludge, using a chemical sludge yield of 80 percent. Based on these assumptions, a total production of 100,000 lbs (dry) per day of primary solids is expected during periods of ADWF. To maintain the same 860,000 gpd solids force main flow rate, solids concentration of sludge pumped to the Southeast plant will be about 1.4 percent.

Alternative N3. Chemical sludge production with low lime treatment was calculated on the basis of stoichiometry and equilibrium relationships.[10, 11] Equilibrium was assumed on the basis that the recycle of sludge would accelerate the rate of reaction in the flocculator. Further, the assumption of equilibrium will result in the most conservative or greatest quantity of solids production.

The plant operations study date (Report 1, Phase I) for calcium and magnesium hardness, alkalinity and phosphorus were used in estimating the solids generation. These values are:

Parameter	Concentration mg/l as $CaCO_3$
Calcium	65
Magnesium	165
Bicarbonate alkalinity	111
Total phosphorus	28 (as $PO_4^{\equiv}$)

Based on a lime dose of 162.5 mg/l (as $Ca(OH)_2$) and a resulting pH of 10, the following concentrations of precipitate are estimated (neglecting ash in the lime feed):

Component	Concentration mg/l
Calcium phosphate complex	
(assumed to be approximately $Ca_5(OH)(PO_4)_3$)	38
$Mg(OH)_2$ precipitate	none
Primary solids (80% removal)	156
$CaCO_3$ precipitate	190
Total (excluding ash)	384

The level of $CaCO_3$ precipitate reflects a 39 mg/l (as $CaCO_3$) loss due to calcium complexing with phosphate, a 57 mg/l gain due to water softening, and a 46 mg/l calcium loss (as $CaCO_3$) with the effluent.

The total solids produced under alternative N3 will reflect any ash fed with the lime feed. Under alternative N3A, no recalcined lime is returned to the process. New lime product contains 8 to 10 percent ash, so that approximately 7,000 lbs per day of ash is fed with the approximately 72,500 lbs per day of CaO. On a dry weather basis, the total solids produced will be approximately 234,000 lbs (dry) per day of total solids. At the 860,000 gpd

sludge force main flow rate, the solids concentration of sludge pumped to the Southeast plant will be about 3.3 percent.

Under alternative N3B, recalcination is provided to recover reusable calcium oxide. Neglecting ash recycle, it is estimated that the following quantities of recalcine product will be produced:

Component	Rate lbs/day (dry)
Primary solids ash	23,000
Calcium oxide	63,000
Calcium phosphate complex	22,500
Total	108,500

Preliminary pilot data from BSP-Envirotech indicates that "ash benefication" will result in the recovery of approximately 70 percent of the calcium oxide in the recalcine product and that this CaO "rich" product stream will contain 30 percent ash. On this basis, approximately 44,000 lbs per day of recalcined calcium oxide will be recycled (comprising approximately 56 percent of the CaO requirement) and about 28,500 lbs per day of new calcium oxide will be added to the system. The recalcined material will contain approximately 19,000 lbs per day of ash. New calcium oxide will contain about 2,500 lbs per day of ash. Solids production under alternative N3B is estimated at approximately 248,500 lbs per day of dry solids, based on dry weather flow. At the 860,000 gpd sludge force main flow rate, the solids concentration of sludge pumped to the Southeast plant will be about 3.5 percent.

It should be noted that any significant variation in raw water quality will affect the quantities of solids produced and may also affect the feasibility of lime recovery.

Alternative N4A. Precipitate concentrations (neglecting ash in the lime feed) based on high dose lime treatment (300-350 mg/l of $Ca(OH)_2$) with a resulting pH of 11 are estimated as follows:

Component	Concentration mg/l
Calcium phosphate complex	38
$Mg(OH)_2$ precipitate	100
Primary solids (87% removal)	170
$CaCO_3$ precipitate	258
Total (excluding ash)	566

The level of $CaCO_3$ precipitate reflects a 106 mg/l soluble calcium loss (expressed as $CaCO_3$) with the effluent and a 39 mg/l loss due to calcium complexing with phosphate (expressed as $CaCO_3$).

If recalcination were practiced, the following quantities of recalcine

product would be generated (excluding recycle ash):

Component	Rate lbs/day
Primary solids ash	25,000
Magnesium oxide	39,400
Calcium phosphate complex	22,500
Calcium oxide	87,000
Total	173,900

Considering losses in ash benefication, it is estimated that only a maximum of about 35 percent of the lime requirements could be obtained through recalcination for this alternative. This low percent recovery coupled with the cost of hauling and storage makes this process infeasible economically and restricts solids treatment for alternative N4A to incineration alone.

Under alternative N4A, calcium oxide feed is expected to average 145,000 lbs per day. Ash contained in the lime is expected to be approximately 14,000 lbs per day. On a dry weather basis, the total solids generated will be approximately 349,000 lbs per day of dry solids. At the 860,000 gpd solids force main flow rate, the solids concentration of sludge pumped to the Southeast plant will be about 4.9 percent.

Alternate N4B. The high dose ferric chloride chemical treatment under this alternative is expected to attain an 87 percent suspended solids removal with an 80 percent ferric sludge yield. It is anticipated that the chemical dosage of 125 mg/l $FeCl_3$ will generate 150,000 lbs (dry) per day of primary solids during periods of ADWF. To maintain the 860,000 gpd solids force main flow rate, solids concentration of sludge pumped to the Southeast plant will be about 2.1 percent.

Richmond Sunset Water Pollution Control Plant

The quantities of solids produced at the Richmond Sunset plant will increase above the present levels for all alternatives because of the process improvements and changes. For the purposes of these comparisons, ADWF and TSS for the Richmond Sunset plant are assumed to be 28 mgd and 190 mg/l, respectively.

Alternative R1. Under this alternative, the expected 65 percent suspended solids removal during ADWF will result in the production of 28,800 lbs (dry) per day of primary solids. With sludge blanket and density control, the underflow concentration should average at least 5 percent, requiring a raw sludge flow rate of 69,200 gal per day.

Alternative R2. It is expected that the solids production of the primary sedimentation portion of alternative R2 will be the same as for alternative R1 and that the subsequent flotation treatment will result in the additional removal of 40 percent of the suspended solids remaining in the primary sedimentation effluent. Flotation solids are expected to have an average concentration of at least 4 percent and to produce a flow rate of 21,000 gal per day. Total solids production under alternative R2 during dry weather is

expected to average 35,000 lbs (dry) per day. Total raw sludge flow rate is expected to be 91,500 gal per day.

Alternative R3. Under this alternative, the low dose ferric chloride treatment and expected R1 improvements will increase the suspended solids removal to 75 percent (33,200 lbs (dry) per day). In addition it is expected the chemical dosage of 30 mg/l will produce 5,600 lbs (dry) per day of chemical sludge, using a chemical sludge yield of 80 percent. Based on these assumptions, a total production of 38,800 lbs (dry) per day of primary solids expected during periods of ADWF. Due to the presence of light ferric floc in the underflow sludge, it is expected that the sludge concentration will be reduced to 3.5 percent total solids and the raw sludge flow rate increased to 133,000 gal per day.

Alternative R4A. Under this alternative, it is expected that the solids production of the primary sedimentation portion will be the same as for alternative R1. At an aeration tank loading of 50 lbs/1000 cu ft/day and a MLVSS level of 2,100 mg/l, it is expected the substrate removal rate will be 0.38 lbs BOD/lb MLVSS/day. Using typical sludge yields and endogenous metabolism rates (Y=0.55 lbs MLVSS grown/lb MLVSS, K=0.05 lbs MLVSS destroyed/lb MLVSS/day and effluent TVSS=20 mg/l), it is estimated that the activated sludge treatment process will produce 9,600 lbs (dry) of solids per day during periods of ADWF. At a one percent return sludge concentration, the waste sludge flow rate will be 115,000 gal per day. Total solids production under alternative R4A, during dry weather, is expected to average 38,400 lbs (dry) per day.

Alternative R4B. The plant operations study data (Report 1, Phase I) for calcium and magnesium hardness, alkalinity and phosphorus were used in estimating solids production. These values are:

Parameter	Concentration mg/l as $CaCO_3$
Calcium	50
Magnesium	49
Bicarbonate alkalinity	141
Total phosphorus	34 (as $PO_4^{\equiv}$)

Based on a lime dose of approximately 240-280 mg/l (as $Ca(OH)_2$) and a resulting pH of 11, the following concentrations of precipitate are estimated (neglecting ash in the lime feed):

Component	Concentration mg/l
Calcium phosphate complex	43
$Mg(OH)_2$ precipitate	29
Primary solids (87% removal)	166
$CaCO_3$ precipitate	337
Total (excluding ash)	575

The level of $CaCO_3$ precipitate reflects a 38 mg/l (as $CaCO_3$) loss due to phosphorus, a 35 mg/l gain due to water softening, and a calcium loss of 10 mg/l (as $CaCO_3$) with the effluent.

Neglecting ash recycle, it is estimated that the following quantities of recalcine product will be produced:

Component	Rate lbs/day
Primary solids ash	5,800
Calcium oxide	42,800
Calcium phosphate complex	10,000
Magnesium oxide	4,700
Total	63,300

Ash benefication (see alternative N3), will result in 30,400 lbs of CaO per day in the CaO rich product stream. This product will contain about 20 percent ash. On this basis, approximately 67 percent of the lime demand will be provided by the recycled CaO and about 14,700 lbs per day of new calcium oxide will be added to the system. The recalcined calcium oxide will contain approximately 7,600 lbs per day of ash and the new calcium oxide about 1,300 lbs per day of ash. Solids production under alternative R4B is estimated at 143,300 lbs (dry) per day of total solids on a dry weather basis. At a 5 percent solids concentration, the underflow rate will be 345,000 gal per day.

Southeast Water Pollution Control Plant

The quantities of solids produced at the Southeast plant, like the other two plants, will increase above the present levels for all alternatives because of the process improvements and changes. For the purposes of these comparisons, ADWF and TSS for the Southeast plant are assumed to be 36 mgd and 420 mg/l, respectively.

Alternative S1. Under this alternative, the expected 65 percent suspended solids removal during ADWF will result in the production of 82,000 lbs (dry) per day of primary solids. With sludge blanket and density control, the underflow concentration should average at least 5 percent, requiring a raw sludge flow rate of 196,500 gal per day.

Alternative S2A. It is expected that solids production of the primary sedimentation portion of alternative S2A will be the same as for alternative S1 and that subsequent flotation treatment will result in the additional removal of 40 percent of the suspended solids remaining in the primary sedimentation effluent. Flotation solids are expected to have an average concentration of at least 4 percent and to produce a flow rate of 52,800 gal per day. Total solids production under alternative S2A during dry weather is expected to average 99,600 lbs per day. Total raw sludge flow rate is expected to be 249,300 gal per day.

Alternative S2B. Under this alternative, the low dose ferric chloride treatment and expected S1 improvements will increase suspended solids removal to 75 percent (94,500 lbs (dry) per day). In addition, it is expected the chemical dosage of 30 mg/l will produce 7,200 lbs (dry) per day of chemical sludge, using a chemical sludge yield of 80 percent. Based on these assumptions, a total production of 101,700 lbs (dry) per day of primary solids is expected during periods of ADWF. Due to the presence of light ferric floc in the underflow sludge, it is expected that the underflow concentration will be reduced to 3.5 percent total solids and the raw sludge flow rate increased to 348,000 gal day.

Alternative S3. Under this alternative, it is expected that the solids production of the primary sedimentation portion of alternative S3 will be the same as for alternative S1. At an aeration tank loading of 50 lbs/1000 cu ft/day and a MLVSS level of 2100 mg/l, it is expected the substrate removal rate will be 0.35 lbs BOD/lb MLVSS/day. Using typical sludge yields and endogenous metabolism rates (Y = 0.55 lbs MLVSS grown/lb MLVSS, K = 0.05 lbs MLVSS destroyed/lb MLVSS/day and effluent TVSS = 20 mg/l), it is estimated that the activated sludge treatment process will produce 17,200 lbs (dry) of solids per day during periods of ADWF. At a one percent return sludge concentration, the waste sludge flow rate will be 207,000 gal per day. Total solids production during dry weather is expected to average 99,200 lbs (dry) per day.

Alternative S4A. The plant operations study data (Report 1, Phase I) for calcium and magnesium hardness, alkalinity and phosphorus were used in estimating the solids generation. These values are:

Parameter	Concentration mg/l as $CaCO_3$
Calcium	179
Magnesium	383
Bicarbonate alkalinity	120
Total phosphorus	30

Based on a lime dose of approximately 450-550 mg/l (as $Ca(OH)_2$) and a resulting pH of 11, the following concentrations of precipitate are estimated (neglecting ash in the lime feed):

Component	Concentration mg/l
Calcium phosphate complex	39
$Mg(OH)_2$ precipitate	222
Primary solids (87% removal)	365
$CaCO_3$ precipitate	282
Total (excluding ash)	908

The level of $CaCO_3$ precipitate reflects a 67 mg/l (as $CaCO_3$) loss due to phosphorus and a soluble calcium loss of 480 mg/l (as $CaCO_3$) with the effluent.

An analysis of alternative S4A, similar to that presented for alternative N4A, indicates that only 29 percent of the lime demand can be satisfied by recalcination. This low percent recovery is due to the high calcium loss in the effluent and the high magnesium content of the precipitate. With such a low recovery, recalcination is not considered practical and only incineration is provided.

Under alternative S4A, calcium oxide feed is expected to average 105,000 lbs per day. Ash contained in the lime is expected to be approximately 9,000 lbs per day. On a dry weather basis, the total solids produced will be approximately 272,000 lbs per day of dry solids. At 5 percent underflow concentration, the underflow rate will be 652,000 gal per day.

Alternative S4B. The high dose ferric chloride chemical treatment under this alternative is expected to attain a 87 percent suspended solids removal with a 80 percent ferric sludge yield. It is anticipated that the chemical dosage of 125 mg/l $FeCl_3$ will produce 139,000 lbs (dry) per day of primary solids during periods of ADWF. Due to the presence of light ferric floc in the sludge, it is expected that the underflow concentration will be reduced to 2.5 percent total solids and the raw sludge flow rate increased to 667,000 gal per day.

Summary

Table A-2 presents the ADWF dry solids production and the raw sludge or underflow solids concentration and flow rate for each alternative for each plant.

SOLIDS TREATMENT AND DISPOSAL

In developing alternatives for solids treatment and disposal, ideal mass and liquid balances were assumed. While it is realized actual operation will not attain these ideals, it is anticipated that the facilities developed using these assumptions will be conservative and will successfully achieve the results expected.

North Point Water Pollution Control Plant

Although solids treatment and disposal is not provided at the North Point plant, required facilities for North Point solids at the Southeast plant have been analyzed separately so that the true cost of solids treatment and disposal could be developed for each alternative. Where existing facilities are utilized, it has been determined either that they are not needed for treating Southeast solids or that they require only one-half of the existing facilities for North Point solids with the other half retained for the treatment of Southeast solids.

Alternative N1. Under this alternative, it is expected that the existing gravity thickening facilities, on the basis of a thickening loading of 20 lbs/sq ft/day, will have to be enlarged to a total of 3750 square feet of surface area with an additional incremental allowance for adequate standby. It is anticipated that the 860,000 gpd of force main sludge at 1.1 percent solids

TABLE A-2

SEWAGE TREATMENT SOLIDS PRODUCTION

Plant	Alternative	Dry solids produced at ADWF lbs/day	Raw sludge or underflow Percent total solids	Raw sludge or underflow Flow rate gal/day
North Point	N1	75,000	1.1	860,000
	N2	100,000	1.4	860,000
	N3A	234,000	3.3	860,000
	N3B	248,500	3.5	860,000
	N4A	349,000	4.9	860,000
	N4B	150,000	2.1	860,000
Richmond Sunset	R1	28,800	5.0	69,200
	R2	35,000	4.0 & 5.0	91,500
	R3	38,800	3.5	133,000
	R4A	38,400	1.0 & 5.0	184,200
	R4B	143,300	5.0	345,000
Southeast	S1	82,000	5.0	196,500
	S2A	99,600	4.0 & 5.0	249,300
	S2B	101,700	3.5	348,000
	S3	99,200	1.0 & 5.0	403,500
	S4A	272,000	5.0	652,000
	S4B	139,000	2.5	667,000

will be reduced to 125,000 gpd of 5 percent thickened sludge. The thickener overflow (635,000 gpd) will be returned by gravity to the pump discharge structure.

The 75,000 lbs (dry) per day of solids will load three of the existing group 1 digesters at a rate of 0.104 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the thickened sludge will have a volatile content of 75 percent, that digestion will result in a 60 percent volatile solids reduction, and that digested sludge will be consolidated to 6 percent total solids. The volatile solids destruction and digested sludge consolidation will result in the production of 41,200 lbs (dry) per day of digested solids (82,000 gpd) and 43,000 gpd of digester supernatant.

The new chemical and sludge handling facilities are assumed to allow the existing filters to be loaded at the rate of 5 lbs (dry digested solids)/sq ft/hour. On this basis, one-half of the existing filtering equipment (925 sq ft) will have capacity to dewater digested sludge resulting from North Point solids by operating 10 hours/day, 6 days/week. For the purpose of this study, it is assumed that the dry filtered solids will contain 71 percent digested solids, 25 percent lime and 4 percent ferric chloride and that the filter cake produced will contain 25 percent solids.

Maximum filtrate production will be 7,200 gph making the maximum supernatant plus filtrate flow 9,000 gph. Slaked lime and ferric chloride use is expected to average 14,400 and 2,400 lbs per day, respectively. Filter cake production, including chemicals, will average 232,000 lbs per day. Average filtrate plus supernatant flow will be 105,000 gal/day.

Alternative N2. The poor settling characteristics of the sludge produced under this alternative results in a decrease of the loading rate for the gravity thickeners to 15 lbs/sq ft/day. On this basis, alternative N2 will require enlargement of the existing gravity thickening facilities to a total of 6,700 square feet of surface area with an additional incremental allowance for adequate standby. It is anticipated that the 860,000 gpd of force main sludge at 1.4 percent solids will be reduced to 343,000 gpd of 3.5 percent thickened sludge. Thickener overflow (517,000 gpd) will be returned by gravity to the pump discharge structure.

The 100,000 lbs (dry) per day of solids will load four of the existing group 1 digesters at a rate of 0.104 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It is assumed that the organic solids of the thickened sludge will have a volatile content of 75 percent, that digestion will result in a 60 percent volatile solids reduction, and that the digested thickened sludge will be consolidated to 5.5 percent total solids. The volatile solids reduction and digested sludge consolidation will result in the production of 61,000 lbs (dry) per day of digested solids (133,000 gpd) and 210,000 gpd of digester supernatant.

To improve the filtering capabilities without the addition of any further chemicals, heat conditioning of the digested sludge is proposed. This treatment will allow the existing filters to be loaded at the rate of 10 lbs/sq ft/hour. On this basis, one-half of the existing filtering equipment (925 sq ft)

will have capacity to dewater digested sludge resulting from the North Point solids by operating about 8 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake will contain 35 percent solids.

Maximum heat treatment capability will be 20,000 gph and maximum heat treatment decant and filtrate flow will be 16,300 gal/hour. Maximum supernatant plus decant and filtrate flow will be approximately 25,000 gal/hour. Filter cake production will average 174,000 lbs/day. Average supernatant, heat treatment decant and filtrate flow will be 322,000 gal/day.

Alternative N3A. Under this alternative, the heavy sludge produced as a result of lime treatment permits an increase in the loading rate for the gravity thickeners to 35 lbs/sq ft/day. On this basis, alternative N3A will require enlargement of the existing gravity thickening facilities to a total of 6,700 square feet of surface area with an additional incremental allowance for adequate standby. It is anticipated that the 860,000 gpd of force main sludge at 3.3 percent solids will be reduced to 331,000 gpd of 8.5 percent thickened sludge. Thickener overflow (529,000 gpd) will be returned by gravity to the pump discharge structure.

The 331,000 gallons per day of thickened sludge will be retained in four of the existing group 1 digesters for approximately 22 days, leaving ample capacity for PWWF loadings and operating flexibility. The organic solids (91,000 lbs (dry) per day) contained in the sludge will result in a loading of 0.095 lbs/cu ft/day. It is assumed that the organic solids of the thickened sludge will have a volatile content of 75 percent, that digestion will result in a 60 percent volatile solids reduction, and that the digested thickened sludge will have the same percent solids as the raw thickened sludge. The volatile solids reduction will result in the production of 193,000 lbs (dry) per day of digested solids (273,000 gpd) and 58,000 gpd of digester supernatant.

Lime treated sludge is assumed to require no further conditioning to allow the existing and new filters to be loaded at the rate of 7 lbs (dry digested solids)/sq ft/hour. On this basis, one-half of the existing filtering equipment plus two additional 11.5 x 16 filters (2,075 sq ft) will have capacity to dewater digested sludge resulting from North Point solids by operating about 16 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake produced will contain 35 percent solids.

Maximum filtrate flow will be 15,000 gph making the maximum supernatant plus filtrate flow about 18,000 gph. Filter cake production will average 552,000 lbs per day and average filtrate plus supernatant flow will be 265,000 gal/day.

Alternative N3B. Under this alternative, the heavy sludge produced as a result of lime treatment permits an increase in the loading rate for the gravity thickeners to 35 lbs/sq ft/day. On this basis, alternative N3B will require enlargement of the existing gravity thickening facilities to a total of 7,100 square feet of surface area with an additional increment allowance for adequate standby. It is anticipated that the 860,000 gpd of force main sludge at 3.5 percent solids will be reduced to 352,000 gpd of 8.5 percent thickened sludge. Thickener overflow (508,000 gpd) will be returned by gravity to the pump discharge structure.

The lime treated sludge is assumed to require no further conditioning to allow the existing and new filters to be loaded at the rate of 7 lbs (dry solids)/sq ft/hour. On this basis, one-half of the existing filtering equipment plus two additional 11.5 x 16 filters (2,075 sq ft) will have capacity to dewater solids from the North Point plant by operating about 20 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake produced will contain 35 percent solids.

Maximum filtrate flow will be 16,000 gph with an average flow of [illegible]7,000 gal/day. With new and recycled chemical ash (21,500 lbs per day) and grit and screening ash (7,400 lbs per day), the total pounds of inerts discharged from the incinerator will be 137,400 lbs per day. It is expected that 63,000 lbs per day of CaO and ash will be recycled and that 74,400 lbs per day of ash will be wasted. The ash, when wetted to 80 percent solids, will produce 95,000 lbs per day of material to be hauled to suitable disposal sites.

Alternative N4A. As indicated with alternatives N3A and N3B, the heavy lime sludge is expected to permit an increase in the loading rate for the gravity thickening to 35 lbs/sq ft/day. On this basis, alternative N4A will require enlargement of the existing gravity thickening facilities to a total of 10,000 square feet of surface area with an additional increment allowance for adequate standby. It is anticipated that the 860,000 gpd of force main sludge at 4.9 percent solids will be reduced to 493,000 gpd of 8.5 percent thickened sludge. Thickener overflow (367,000 gpd) will be returned by gravity to the pump discharge structure.

The lime treated sludge is assumed to require no further conditioning to allow the existing and new filters to be loaded at the rate of 10 lbs (dry thickened solids)/sq ft/hour. On this basis, half of the existing filtering equipment plus two additional 11.5 x 16 filters (2,075 sq ft) will have capacity to dewater solids from the North Point plant by operating about 20 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake produced will contain 40 percent solids.

Maximum filtrate flow will be 23,000 gph with average flow of 388,500 gal/day. Incineration inert production will include the following components:

Component	Rate lbs per day
Primary solids ash	25,000
Chemical ash	14,000
Magnesium oxide	59,000
Calcium phosphate complex	22,500
Calcium carbonate	153,000
Grit ash	6,600
Screenings ash	800
Total	280,900

This inert material, when wetted to 80 percent solids, will produce 358,000 lbs per day of ash to be hauled to suitable disposal sites.

Alternative N4B. The poor settling characteristics of the ferric chloride sludge produced under alternative N4B is expected to make it necessary to use flotation type thickeners with a loading rate of 20 lbs/sq ft/day. On this basis, 7,500 sq ft of flotation type thickeners with an additional increment allowance for adequate standby will be required. It is anticipated that the 860,000 gpd of force main sludge at 2.1 percent solids will be reduced to ,,000 gpd of 4.0 percent thickened sludge. Thickener overflow (410,000 gpd) will be returned by gravity to the pump discharge structure.

The 450,000 gallons per day of thickened sludge will be retained in all five of the existing group 1 digesters for approximately 20 days, leaving ample capacity for PWWF loadings and operating flexibility. The organic solids (100,000 lbs (dry) per day) contained in the sludge will result in a loading of 0.083 lbs/cu ft/day. It is assumed that the organic solids of the thickened sludge will have a volatile content of 75 percent, that digestion will result in a 60 percent volatile solids reduction, and that the digested thickened sludge will have the same percent solids as the raw thickened sludge. The volatile solids reduction will result in the production of 105,000 lbs (dry) per day of digested solids (315,000 gpd) and 135,000 gpd of digester supernatant.

To improve the filtering capabilities without the addition of any further chemicals, heat conditioning of the digested sludge is proposed. This treatment will allow the existing filters to be loaded at the rate of 10 lbs (dry digested solids)/sq ft/hour. On this basis, one-half of the existing filtering equipment (925 sq ft) will have capacity to dewater digested sludge resulting from the North Point solids by operating about 14 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake will contain 35 percent solids.

Maximum heat treatment capability will be 27,000 gph and maximum heat treatment decant and filtrate flow will be 23,300 gal/hour. Maximum supernatant plus decant and filtrate flow will be approximately 29,000 gal/hour. Filter cake production will average 300,000 lbs/day. Average supernatant, heat treatment decant and filtrate flow will be 414,000 gal/day.

Richmond Sunset Water Pollution Control Plant

The Richmond Sunset plant provides treatment and disposal for solids removed during the sewage treatment process within the plant.

Alternative R1. Under this alternative, it is expected that the 28,000 lbs (dry) per day of solids will load the two digesters at a rate of 0.068 lbs/cu ft/day leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the raw sludge will have a volatile content of 85 percent, that digestion will result in a 70 percent volatile solids reduction, and that digested sludge will be consolidated to 6 percent total solids. The volatile solids destruction and digested sludge consolidation will result in the production of 11,600 lbs (dry) per day of digested solids (23,400 gpd) and 45,800 gpd of digester supernatant.

The new chemical and sludge handling facilities are assumed to allow the existing filters to be loaded at the rate of 5 lbs (dry digested solids)/sq ft/hour. On this basis, the existing filtering equipment (400 sq ft) will have capacity to dewater the digested sludge by operating approximately 8 hours/day, 5 days/week. For the purpose of this study, it is assumed that the dry filtered solids will contain 71 percent digested solids, 25 percent lime and 4 percent ferric chloride and that the filter cake produced will contain 25 percent solids.

Maximum filtrate production will be 3,050 gph making the maximum supernatant plus filtrate flow 5,000 gal/hour. Slaked lime and ferric chloride use is expected to average 4,100 and 650 lbs per day, respectively. Filter cake production, including chemicals, will average 65,000 lbs per day. Average filtrate plus supernatant flow will be 63,600 gal/day.

Alternative R2. This alternative will load the two digesters at a rate of 0.081 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the raw sludge will have the same volatile solids content, digestion will result in the same volatile solids reduction, and digested sludge consolidation will be the same as expected for alternative R1. The volatile solids destruction and digested sludge consolidation will result in the production of 14,200 lbs (dry) per day of digested sludge (28,400 gpd) and 61,400 gpd of digester supernatant.

With a filter loading rate the same as alternative R1, it is expected that the existing filtering equipment (400 sq ft) will have capacity to dewater the digested sludge by operating approximately 10 hours/day, 5 days/week. For the purpose of this study, the filter cake chemical make-up and percent solids are assumed the same as alternative R1.

Maximum filtrate production will be 3,050 gph making the maximum supernatant plus filtrate flow approximately 6,000 gal/hour. Slaked lime and ferric chloride use is expected to average 5,000 and 800 lbs/day, respectively. Filter cake production, including chemicals, will average 80,000 lbs/day. Average filtrate plus supernatant flow will be 83,000 gal/day.

Alternative R3. The poor settling characteristics of the chemical sludge produced under this alternative will result in a much larger liquid loading on the digesters. Even with this increase, loading of the two digesters will be only 0.092 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the organic solids content of the raw sludge will have a volatile content of 85 percent, that the digestion will result in a 70 percent volatile solids reduction, and that the digested sludge will be consolidated to 5.5 percent total solids. The volatile solids reduction and digested sludge consolidation will result in the production of 19,000 lbs (dry) per day of digested solids (41,500 gpd) and 91,500 gpd of digester supernatant.

To improve the filtering capabilities without the addition of any further chemicals, heat conditioning of the digested sludge is proposed. This treatment will allow the existing filters to be loaded at the rate of 10 lbs/sq ft/hour. On this basis, the existing filtering equipment (400 sq ft)

will have capacity to dewater the digested sludge by operating approximately 6-1/2 hours/day, 5 days/week. For the purpose of this study, it is assumed that the filter cake will contain 35 percent solids.

Maximum heat treatment capability will be 9,000 gph and maximum heat treatment decant and filtrate flow will be 7,350 gal/hour. Maximum supernatant plus decant and filtrate flow will be approximately 12,000 gal/hour. Filter cake production will average 54,400 lbs/day. Average supernatant, heat treatment decant and filtrate flow will be 126,500 gal/day.

Alternative R4A. Under this alternative, the waste activated sludge solids will be treated by flotation type thickeners prior to entering the digesters. Thickener loading rate will be maintained at 20 lbs/sq ft/day requiring facilities with about 500 sq ft of surface area plus an additional equal allowance for adequate standby. It is anticipated that the 115,000 gpd of waste activated sludge at one percent solids will be reduced to 28,800 gpd of 4.0 percent thickened sludge. Thickener overflow (86,200 gpd) will be returned by gravity to the grit chamber collection channel.

The 38,400 lbs (dry) per day of solids will load the two digesters at a rate of only 0.091 lbs/cu ft/day leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the raw sludge and thickened sludge will have the same volatile solids content, digestion will result in the same volatile solids reduction, and digested sludge consolidation will be the same as expected for alternative R1. The volatile solids destruction and digested sludge consolidation will result in the production of 15,600 lbs (dry) per day of digested sludge (31,200 gpd) and 66,800 gpd of digester supernatant.

With a filter loading rate similar to alternative R1, it is expected that the existing filtering equipment (400 sq ft) will have capacity to dewater the digested sludge by operating approximately 11 hours/day, 5 days/week. For the purpose of this study, the filter cake chemical make-up and percent solids are assumed to be similar to alternative R1.

Maximum filtrate production will be 3,050 gph making the maximum supernatant plus filtrate flow about 6,000 gal/hour. Slaked lime and ferric chloride use is expected to average 5,500 and 880 lbs/day, respectively. Filter cake production, including chemicals, will average 88,000 lbs/day. Average filtrate plus supernatant flow will be 90,500 gal/day.

Alternative R4B. The heavy sludge produced as a result of lime treatment permits the loading rate for gravity thickeners used to consolidate the sludge to be 35 lbs/sq ft/day. On this basis, alternative R4B will require 4,200 square feet of gravity thickener surface area with temporary storage within one digester providing standby capability. It is anticipated that the 345,000 gpd of raw chemical sludge at 5.0 percent solids will be reduced to 203,000 gpd of 8.5 percent thickened sludge. Thickener overflow (142,000 gal/day) will be returned by gravity to the grit chamber collection channel.

The lime treated sludge is assumed to require no further conditioning to allow three new 8 x 14 filters (1,050 sq ft) to be loaded at the rate of 10 lbs (dry solids)/sq ft/hour. At this rate, these filters will have capacity to dewater the thickened chemical sludge by operating about 19 hours/day, 5 days/week. For the purpose of this study, it is assumed that the filter cake produced will contain 40 percent solids.

Maximum filtrate flow will be 8,000 gph with an average flow of 160,000 gal/day. With new and recycled chemical ash (8,900 lbs/day) and grit and screening ash (2,800 lbs/day), the total pounds of inerts discharged from the incinerator will be 75,000 lbs per day. It is expected that 38,000 lbs/day of CaO and ash will be recycled and that 37,000 lbs/day of ash will be wasted. The ash, when wetted to 80 percent solids, will produce 46,000 lbs per day of material to be hauled to suitable disposal sites.

Southeast Water Pollution Control Plant

As indicated under the North Point plant write-up, the Southeast solids treatment and disposal facilities are used by both plants. In developing the alternatives for each plant, it has been necessary to determine an equitable sharing of these facilities. This determination has resulted in the existing thickening facilities being completely allocated to the treatment of the North Point solids while the existing digestion and filtering facilities have been split equally between the two loads.

Alternative S1. Under this alternative, it is expected that the 82,000 lbs (dry) per day of solids will load 4 of the group 2 digesters at a rate of 0.086 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the raw sludge will have a volatile content of 73 percent, that digestion will result in a 60 percent volatile solids reduction, and that digested sludge will be consolidated to 6 percent total solids. The volatile solids destruction and digested sludge consolidation will result in the production of 46,200 lbs (dry) per day of digested solids (92,300 gpd) and 104,200 gpd of digester supernatant.

The new chemical and sludge handling facilities are assumed to allow the existing filters to be loaded at the rate of 5 lbs (dry digested solids)/sq ft/hour. On this basis, one-half of the existing filters (925 sq ft) will have capacity to dewater the digested sludge by operating approximately 12 hours/day, 6 days/week. For the purpose of this study, it is assumed that the dry filtered solids will contain 71 percent digested solids, 25 percent lime and 4 percent ferric chloride and that the filter cake produced will contain 25 percent solids.

Maximum filtrate production will be 6,800 gph making the maximum supernatant plus filtrate flow about 12,000 gal/hour. Slaked lime and ferric chloride use is expected to average 16,300 and 2,600 lbs per day, respectively. Filter cake production, including chemicals, will average 260,000 lbs/day. Average filtrate plus supernatant flow will be 174,300 gal/day.

Alternative S2A. This alternative is expected to load four of the existing digesters of group 2 at a rate of 0.104 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the raw sludge will have the same volatile solids content, digestion will result in the same volatile solids reduction, and digested sludge consolidation will be the same as expected for alternative S1. The volatile solids destruction and digested sludge consolidation will result in the production of 56,000 lbs (dry) per day of digested sludge (112,000 gpd) and 137,300 gal/day of digester supernatant.

With a filter loading rate the same as alternative S1, it is expected that one-half of the existing filtering equipment (925 sq ft) will have capacity to

dewater the digested sludge by operating approximately 14 hours/day, 6 days/week. For the purpose of this study, the filter cake chemical make-up and percent solids are assumed the same as alternative S1.

Maximum filtrate production will be 7,100 gph making the maximum supernatant plus filtrate flow approximately 13,000 gal/hour. Slaked lime and ferric chloride use is expected to average 19,700 and 3,200 lbs/day, respectively. Filter cake production, including chemicals, will average 316,000 lbs/day. Average filtrate plus supernatant will be 222,500 gal/day.

Alternative S2B. The poor settling characteristics of the chemical sludge produced under this alternative will result in a much larger liquid loading on the digesters. The organic and chemical solids, however, are expected to load four of the existing group 2 digesters at a rate of only 0.106 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the organic solids content of the raw sludge will have a volatile content of 73 percent, that the digestion will result in a 70 percent volatile solids reduction, and that the digested sludge will be consolidated to 5.5 percent total solids. The volatile solids reduction and digested sludge consolidation will result in the production of 60,300 lbs (dry) per day of digested solids (121,000 gpd) and 227,000 gpd of digester supernatant.

To improve the filtering capabilities without the addition of any further chemicals, heat conditioning of the digested sludge is proposed. This treatment will allow the existing filters to be loaded at the rate of 10 lbs/sq ft/hour. On this basis, one-half of the existing filters (925 sq ft) will have capacity to dewater the digested sludge by operating approximately 8 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake will contain 35 percent solids.

Maximum heat treatment capability will be 19,000 gph and maximum heat treatment decant and filtrate flow will be 15,300 gal/hour. Maximum supernatant plus decant and filtrate flow will be approximately 25,000 gal/hour. Filter cake production will average 173,000 lbs/day. Average supernatant, heat treatment decant and filtrate flow will be 327,400 gal/day.

Alternative S3. Under this alternative the waste activated sludge solids will be treated by flotation type thickeners prior to entering the digesters. Thickening loading rate will be maintained at 20 lbs/sq ft/day requiring facilities with about 900 sq ft of surface area plus an additional equal allowance for adequate standby. It is anticipated that the 207,000 gpd of waste activated sludge at one percent solids will be reduced to 51,600 gpd of 4.0 percent thickened sludge. Thickener overflow (155,400 gpd) will be returned by gravity to the pump discharge structure.

The 99,200 lbs (dry) per day of solids will load four of the existing group 2 digesters at a rate of 0.103 lbs/cu ft/day, leaving ample capacity for PWWF loadings and operating flexibility. It has been assumed that the raw sludge and thickened sludge will have the same volatile solids content, digestion will result in the same volatile solids reduction, and digested sludge consolidation will be the same as expected for alternative S1. The volatile solids destruction and digested sludge consolidation will result in the production of 55,700 lbs (dry) per day of digested sludge (111,000 gpd) and 135,000 gpd of digester supernatant.

With a filter loading rate similar to alternative S1, it is expected that one-half of the existing filtering equipment (925 sq ft) will have capacity to dewater the digested sludge by operating approximately 14 hours/day, 6 days/week. For the purpose of this study, the filter cake chemical make-up and percent solids are assumed similar to alternative S1.

Maximum filtrate production will be 7,000 gph making the maximum supernatant plus filtrate flow about 13,000 gal/hour. Slaked lime and ferric chloride use is expected to average 19,600 and 3,200 lbs/day, respectively. Filter cake production, including chemicals, will average 314,000 lbs/day. Average filtrate plus supernatant flow will be 219,200 gal/day.

Alternative S4A. The heavy sludge produced as a result of lime treatment permits the loading rate for gravity thickeners used to consolidate the sludge to be 35 lbs/sq ft/day. On this basis, alternative S4A will require 7,800 square feet of gravity thickener surface area with an additional incremental allowance for adequate standby. It is anticipated that the 652,000 gpd of raw chemical sludge at 5.0 percent solids will be reduced to 272,000 gpd of 8.5 percent thickened sludge. Thickener overflow (380,000 gpd) will be returned by gravity to the pump discharge structure.

The lime treated sludge is assumed to require no further conditioning to allow one-half the existing filters plus one new 11.5 x 16 filter (1,500 sq ft) to be loaded at the rate of 10 lbs (dry solids)/sq ft/hour. At this rate, these filters will have capacity to dewater the thickened chemical sludge by operating about 22 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake produced will contain 40 percent solids.

Maximum filtrate flow will be 10,000 gph with an average flow of 190,000 gal/day. Incineration inert production will include the following components:

Component	Rate lbs per day
Primary solids ash	29,500
Chemical ash	9,000
Magnesium oxide	66,400
Calcium phosphate complex	11,600
Calcium carbonate	75,000
Grit ash	3,300
Screening ash	400
Total	195,200

This inert material, when wetted to 80 percent solids, will produce 250,000 lbs per day of ash to be hauled to suitable disposal sites.

Alternative S4B. The poor settling characteristics of the ferric chloride sludge produced under alternative S4B is expected to make it necessary to use flotation type thickeners with a loading rate of 20 lbs/sq ft/day. On this basis, 7,000 sq ft of flotation type thickeners with an additional increment allowance for adequate standby will be required. It is anticipated that the 667,000 gpd of raw chemical sludge at 2.5 percent solids will be reduced to 417,000 gpd of 4.0 percent thickened sludge. Thickener overflow (250,000 gpd) will be returned by gravity to the pump discharge structure.

The 417,000 gallons per day of thickened sludge will be retained in all five of the existing group 2 digesters for approximately 21.5 days, leaving ample capacity for PWWF loadings and operating flexibility. The organic solids (109,000 lbs (dry) per day) contained in the sludge will result in a loading of 0.091 lbs/cu ft/day. It is assumed that the organic solids of the thickened sludge will have a volatile content of 73 percent, that digestion will result in a 60 percent volatile solids reduction, and that the digested thickened sludge will have the same percent solids as the raw thickened sludge. The volatile solids reduction will result in the production of 91,000 lbs (dry) per day of digested solids (273,000 gpd) and 144,000 gpd at digester supernatant.

To improve the filtering capabilities without the addition of any further chemicals, heat conditioning of the digested sludge is proposed. This treatment will allow the existing filters to be loaded at the rate of 10 lbs (dry digested solids)/sq ft/hour. On this basis, one-half of the existing filtering equipment (925 sq ft) will have capacity to dewater digested sludge by operating about 12 hours/day, 6 days/week. For the purpose of this study, it is assumed that the filter cake will contain 35 percent solids.

Maximum heat treatment capability will be 27,000 gph and maximum heat treatment decant and filtrate flow will be 23,500 gal/hour. Maximum supernatant plus decant and filtrate flow will be approximately 30,000 gal/hour. Filter cake production will average 260,000 lbs/day. Average supernatant, heat treatment decant and filtrate flow will be 386,000 gal/day.

Summary

Table A-3 presents the solids thickening criteria for each alternative for each plant. Solids digestion criteria for each alternative for each plant is summarized in Table A-4. Similar summaries for solids conditioning and filtration and incineration are presented in Tables A-5 and A-6.

TABLE A-3

SOLIDS THICKENING

Plant	Alternative	Type	Loading rate lbs/sq ft/day	Surface area required sq ft	Thickened sludge pro-duction gpd	Thickened sludge conc percent solids	Overflow production gpd
North Point	N1	gravity	20	3,750	125,000	5.0	635,000
	N2	gravity	15	6,700	343,000	3.5	517,000
	N3A	gravity	35	6,700	331,000	8.5	529,000
	N3B	gravity	35	7,100	352,000	8.5	508,000
	N4A	gravity	35	10,000	493,000	8.5	367,000
	N4B	flotation	20	7,500	450,000	4.0	410,000
Richmond Sunset	R1	--	--	--	--	--	--
	R2	--	--	--	--	--	--
	R3	--	--	--	--	--	--
	R4A[a]	flotation	20	500	28,800	4.0	86,200
	R4B	gravity	35	4,200	203,000	8.5	142,000
Southeast	S1	--	--	--	--	--	--
	S2A	--	--	--	--	--	--
	S2B	--	--	--	--	--	--
	S3[a]	flotation	20	900	51,600	4.0	155,400
	S4A	gravity	35	7,800	272,000	8.5	380,000
	S4B	flotation	20	7,000	417,000	4.0	250,000

[a] Thickening required only for waste activated sludge.

TABLE A-4

SOLIDS DIGESTION

Plant	Alternative	No in service	Loading rate lbs/cu ft/day	Digested sludge production gpd	Digested sludge conc percent solids	Supernatant production gpd
North Point	N1	3	0.104	82,000	6	43,000
	N2	4	0.104	133,000	5.5	210,000
	N3A	4	0.095[a]	273,000	8.5	58,000
	N3B	2[b]	---	---	-	---
	N4A	2[b]	---	---	-	---
	N4B	5	0.083[a]	315,000	4	135,000
Richmond Sunset	R1	2	0.068	23,400	6	45,800
	R2	2	0.081	28,400	6	61,400
	R3	2	0.092	41,500	5.5	91,500
	R4A	2	0.091	31,200	6	66,800
	R4B	1[b]	---	---	-	---
Southeast	S1	4	0.086	92,300	6	104,200
	S2A	4	0.104	112,000	6	137,300
	S2B	4	0.106	121,000	5.5	227,000
	S3	4	0.103	111,000	6	135,000
	S4A	2[b]	---	---	-	---
	S4B	5	0.091[a]	273,000	4	144,000

[a] Loading rate given for organic solids. Retention for all solids will be about 20 days.

[b] Digesters to be used for raw sludge storage.

TABLE A-5

SOLIDS CONDITIONING AND FILTRATION

Plant	Alternative	Conditioning				Filtration							Max supernatant heat treat and filtrate product
		Type	Max heat cond capacity	Chemicals Used		Filter area		Filter operation			Filter cake		
				$Ca(OH)_2$	$FeCl_3$	exist	new	loading	required time		production wet	conc percent solids	
			gph	lbs/day	lbs/day	sq ft	sq ft	lb/sq ft/hr	hr/day	day/wk	lbs/day		gal/hr
North Point	N1	chemicals	---	14,400	2,400	925	---	5	10	6	232,000	25	9,000
	N2	heat	20,000	---	---	925	---	10	8	6	174,000	35	25,000
	N3A	--	---	---	---	925	1,150	7	16	6	552,000	35	18,000
	N3B	--	---	---	---	925	1,150	7	20	6	710,000	35	16,000
	N4A	--	---	---	---	925	1,150	10	20	6	872,000	40	23,000
	N4B	heat	27,000	---	---	925	---	10	14	6	300,000	35	29,000
Richmond Sunset	R1	chemicals	---	4,100	650	400	---	5	8	5	65,000	25	5,000
	R2	chemicals	---	5,000	800	400	---	5	10	5	80,000	25	6,000
	R3	heat	9,000	---	---	400	---	10	$6\frac{1}{2}$	5	54,400	35	12,000
	R4A	chemicals	---	5,500	880	440	---	5	11	5	88,000	25	6,000
	R4B	--	---	---	---	-	1,050	10	19	5	358,000	40	8,000
Southeast	S1	chemicals	---	16,400	2,600	925	---	5	12	6	260,000	25	12,000
	S2A	chemicals	---	19,700	3,200	925	---	5	14	6	316,000	25	13,000
	S2B	heat	19,000	---	---	925	---	10	8	6	173,000	35	25,000
	S3	chemicals	---	19,600	3,200	925	---	5	14	6	314,000	25	13,000
	S4A	--	---	---	---	925	575	10	22	6	680,000	40	10,000
	S4B	heat	27,000	---	---	925	---	10	12	6	260,000	35	30,000

TABLE A -6

SOLIDS INCINERATION

Plant	Alternative	Loading rates: wet solids lbs/day	Loading rates: dry solids lbs/day	Loading rates: volatile solids lbs/day	Waste: dry ash lbs/day	Waste: wet ash lbs/day	Recycl[e] CaO plu[s] ash lbs/da[y]
North Point	N1	---	---	---	---	---	---
	N2	---	---	---	---	---	---
	N3A	---	---	---	---	---	---
	N3B	760,000	278,500	141,200	74,400	95,000	63,00[0]
	N4A	922,000	378,500	97,600	280,900	358,000	---
	N4B	---	---	---	---	---	---
Richmond Sunset	R1	---	---	---	---	---	---
	R2	---	---	---	---	---	---
	R3	---	---	---	---	---	---
	R4A	---	---	---	---	---	---
	R4B	378,000	155,000	80,000	37,000	46,000	38,00[0]
Southeast	S1	---	---	---	---	---	---
	S2A	---	---	---	---	---	---
	S2B	---	---	---	---	---	---
	S3	---	---	---	---	---	---
	S4A	705,800	287,000	91,800	195,200	250,000	---
	S4B	---	---	---	---	---	---

APPENDIX B

ABBREVIATIONS

APPENDIX B

Abbreviations

(Listed in order of their appearance)

Nos.	numbers
%	percent
mg	milli-grams
/	per
mg/l	milli-grams per liter
ml/l/hr	milli-liters per liter per hour
mgd	million gallons per day
lbs	pounds
No.	number
cu ft	cubic feet
ft	feet
psi	pounds per square inch
BOD	biochemical oxygen demand (5 day, 20C)
DO	dissolved oxygen
rpm	revolutions per minute
min	minute
Fig.	figure
ml	milli-liter
ADWF	average dry weather flow
PDWF	peak dry weather flow
sq ft	square feet
gpd/sq ft	gallons per day per square feet
scfh	standard cubic feet per hour
sec	second
min/hr	minute per hour
hr	hour
gpm/sq ft	gallons per minute per square feet
comp	composite

Abbreviations (cont'd)

pH	hydrogen ion concentration
$Ca(OH)_2$	calcium hydroxide, slaked lime
JTU	Jackson turbidity units
conc	concentration
$FeCl_3$	ferric chloride
$CaCO_3$	calcium carbonate
$<$	less than
$>$	greater than
COD	chemical oxygen demand
MBAS	methylene blue active substance
in.	inch
μ	micro
cm	centimeter
$m\mu$	milli-microns
ie	that is
$\pm$	plus or minus
A.M.	morning hours of day
Floc	flocculation
clar	clarification
CO_2	carbon dioxide
Dec	December
Jan	January
10:1	ten to one
100:1	one hundred to one
eg	for example
G	root mean square velocity gradient
TLm	median tolerance limit
Pb	lead
lbs/day	pounds per day
	approximation

Abbreviations (cont'd)

EPA	Environmental Protection Agency
ENR	Engineering News Record
PWWF	peak wet weather flow
gal	gallons
°F	degrees fahrenheit
psig	pounds per square inch gage
$	dollars
Therm	100,000 British thermal units
CaO	calcium oxide
TSS	total suspended solids
gpd	gallons per day
$Mg(OH)_2$	magnesium hydroxide
PO_4	phosphate
MLVSS	mixed liquor volatile suspended solids
TVSS	total volatile suspended solids
gph	gallons per hour

APPENDIX C

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APPENDIX C

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APPENDIX D

DATA SHEETS FOR

PILOT PLANT STUDIES AT NORTH POINT

Description	Laboratory	No. of Sheets
Routine Analyses of Influent and Effluents	Brown and Caldwell	37
Color Analyses of Influents and Effluents	Brown and Caldwell	5
Toxicity Assays of Effluents	Pacific Environmental Lab	4
Special Analyses (BOD, MBAS, floatables, nutrients) of Influents and Effluents	Brown and Caldwell	5
Grab Samples (influent, effluents and sludge)	Brown and Caldwell	24
Lead Determinations	Brown and Caldwell	5
Mercury Determinations	Brown and Caldwell	3

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 12/28-29/70

Report to: Dr. Parker — Date Received: 12/29/70

Copies to: — Date Reported: 1/05/71

Analysis No.	12323	12324	12325	12326
Source of Sample	Pilot Plant Influent Composite	Pilot Plant Test Effluent Comp.	Pilot Plant Control Effluent	P.P. Flocculator 12/29, 1230 pm
DETERMINATION	Run 1 mg/l	Run 1 mg/l	Run 1 Composite mg/l	mg/l
Suspended Solids (total)	140	32	76	1612
Suspended Solids (Volatile)	130	30	71	
Alkalinity (P) as ($CaCO_3$)	---	119	---	
Alkalinity (MO) as ($CaCO_3$)	117	216	116	
Chemical Oxygen Demand	443	186	279	
Appearance	No Floatables Grey	No Floatables	No Floatables Grey	
Odor	Typical Sewage	Strong Odor Ammonia-like	Typical Sewage	
Grease	55	14	32	
Settleable Solids (ml/l/hr)	5.0	0.05	0.7	
Hydrogen Ion Concentration (pH)	7.3	10.7	7.0	
Turbidity (JTU)	73	18	43	

Comments:

Analyst: S. Kirby, A. Jeong

Reported by: Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: Dec. 29/30, 1970

Report to: Mr. Parker — Date Received: 12/30/70

Copies to: — Date Reported: 1/05/71

Analysis No.	12328	12329	12330	
Source of Sample	Pilot Plant Influent (Comp.)	Pilot Plant-test Effluent (Comp.)	Pilot Plant-Control, Effluent (Comp.)	
DETERMINATION	Run 2 mg/l	Run 2 mg/l	Run 2 mg/l	
Total Suspended Solids	150	40	71	
Volatile Suspended Solids	120	33	69	
Phenolphthalein Alkalinity ($CaCO_3$)	Nil	78		
Total Alkalinity ($CaCO_3$)	93	178		
COD	413	193	299	
Grease	52	6	27	
Appearance	Very Slight Floatables	No Floatables	No Floatables	
Odor	Typical Sewage	Ammonia-like	Typical Sewage	
Settleable Solids (ml/l/hr)	2.5	0.05	1.4	
pH	7.3	10.3	7.1	
Turbidity (JTU)	81	17	58	

Comments:

Analyst: F. Mitchell, A. Jeong, S. Kirby — Reported by: Morris Lipschuetz (signed) Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 12/30-31/70

Report to Mr. Parker — Date Received 12/31/70

Copies to — Date Reported 1/6/71

Analysis No.	12332	12333	12334	12335
Source of Sample	Pilot Plant Influent (Comp.)	Pilot Plant-Test Effluent (Comp.)	Pilot Plant-Control Effluent	Pilot Plant Rapid Mix 1000 AM
DETERMINATION	Run 3 mg/l	Run 3 mg/l	Run 3 (Comp.) mg/l	Run 3 mg/l
Total Suspended Solids	120	56	40	670
Volatile Suspended Solids	120	55	40	
Phenolphthlein Alkalinity ($CaCO_3$)	Nil	144		
Total Alkalinity ($CaCO_3$)	126	226		
COD	420	171	313	
Grease	---	6	---	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Typical Sewage	Ammonia-like	Typical Sewage	
Settleable Solids (ml/l/hr)	3.0	1.1	0.07	
pH	7.7	11.5	7.3	
Turbidity (JTU)	57	18	48	

Comments:

Insufficient sample left for grease determinations on samples 12332 and 12334.

Analyst F. Mitchell, A. Jeong

Reported by Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/4-5/71

Report to Mr. Parker — Date Received 1/5/71

Copies to — Date Reported 1/12/71

Analysis No.	12344	12345	12346	
Source of Sample	Pilot Plant, Run 4 Influent Comp.	Pilot Plant, Run 4 Test Effl. Comp.	Pilot Plant, Run 4 Control Effl. Comp.	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	110	23	54	
Volatile Suspended Solids	100	21	52	
Alkalinity (P) as $CaCO_3$	----	78	----	
Alkalinity (MO) as $CaCO_3$	125	156	126	
COD	418	169	269	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	Ammonia-like	Normal Sewage	
Grease	33	4	22	
Chloride	1280	----	----	
Settleable Solids (ml/l/hr)	2.5	<0.1	<0.1	
pH	7.6	10.6	7.6	
Turbidity (JTU)	61	7.5	44	

Comments:

Analyst F. Mitchell, S. Kirby

Reported by Morris Lipschuetz (signed) Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/5-6/71

Report to Mr. Parker — Date Received 1/6/71

Copies to — Date Reported 1/6/71

Analysis No.	12363	12364	12365	
Source of Sample	P. P. Influent Run 5	P. P. Test Effluent, Run 5	P. P. Control Effluent, Run 5	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	110	7	76	
Volatile Suspended Solids	110	6	75	
Alkalinity (P) as $CaCO_3$		96		
Alkalinity (MO) as $CaCO_3$	120	190		
COD	445	173	281	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	Ammonia- Like	Normal Sewage	
Grease	60	1	42	
Chloride	1160			
MBAS	3.6	2.7	3.4	
Settleable Solids (ml/hr/l)	3.0	<0.05	0.3	
pH	7.4	10.3	7.3	
Turbidity (JTU)	68	7	47	

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/6-7/71

Report to Dr. Parker — Date Received 1/7/71

Copies to — Date Reported 1/14/71

Analysis No.	12374	12375	12376	
Source of Sample	Pilot Plant, Run 6 Influent Comp.	Pilot Plant Run 6 Control Effl. Comp	Pilot Plant, Run 6 Test Effluent Comp.	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	190	106	101	
Volatile Suspended Solids	188	105	97	
Phenolphthalein Alkalinity ($CaCO_3$)			104	
Total Alkalinity ($CaCO_3$)	144		222	
COD	470	328	253	
Grease	31	23	7	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	Normal Sewage	Ammonia-like	
Chloride	1140			
pH	7.1	7.2	9.0	
Turbidity (JTU)	78	58	32	
Settleable Solids (ml/l/hr)	4.0	0.7	0.3	

Comments: Job. No. F265 H

Analyst S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers

Date Collected 24 Hrs. Comp 1/7-8/71

Report to Dr. Parker

Date Received 1/08/71

Copies to

Date Reported 1/22/71

Analysis No.	12403	12404	12405	
Source of Sample	P.P. Run 7, Infl. Comp.	P.P. Run 7, Effl. Test Comp.	P.P. Run 7, Effl. Cont. Comp.	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	170	38	89	
Volatile Suspended Solids	170	38	89	
Phenolphthalein Alkalinity ($CaCO_3$)		98		
Total Alkalinity ($CaCO_3$)	118	~~62~~ 160	138	
COD	472	217	277	
Grease	61	4	40	
Appearance	Some Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	Ammonia-Like	Normal Sewage	
Chloride as Cl	1000	----	---	
pH	7.1	10.2	7.1	
Turbidity (JTU)	52	11	39	
Settleable Solids (ml/l/hr)	3.0	0.4	0.6	

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/12/71

Report to Dr. Parker — Date Received 1/13/71

Copies to — Date Reported 1/22/71

Analysis No.	12417	12418	12419	
Source of Sample	P.P. Run 8, Infl. Comp.	P. P. Run 8 Effl. Test Comp	P. P. Run 8 Effl. Cont. Comp.	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	150	110	130	
Volatile Suspended Solids	110	60	57	
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	110	62		
COD	420	280	271	
Grease	29	12	26	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	None	Normal Sewage	
Chloride	440			
pH	7.3	6.8	7.2	
Turbidity (JTU)	54	80	43	
Settleable Solids (ml/l/hr)	9.0	0.2	0.9	

Comments:

Analyst J. Sehgal, A. Jeong

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Caldwell Engineers — Date Collected 1/13-14/71

Report to Dr. Parker — Date Received 1/14/71

Copies to — Date Reported 1/22/71

Analysis No.	12423	12424	12425	
Source of Sample	P.P. Run 9, Infl. Comp.	P.P. Run 9, Effl. Test Comp.	P. P. Run 9, Effl. Cont. Comp.	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	130	22	76	
Volatile Suspended Solids	110	20	64	
Phenolphthalein Alkalinity ($CaCO_3$)		130		
Total Alkalinity ($CaCO_3$)	112	186		
COD	384	185	278	
Grease	52	6	33	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	Ammonia-Like	Normal Sewage	
Chloride	280			
pH	7.2	11.0	8.0	
Turbidity (JTU)	48	8	44	
Settleable Solids (ml/l/hr)	5.0	<0.1	0.25	

Comments:

Analyst J. Sehgal, M. Lipschuetz

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/14/71

Report to Mr. Parker — Date Received 1/14/71

Copies to — Date Reported 1/22/71

Analysis No.	12426	12427	12428	
Source of Sample	P. P. Run 9A, Infl. Comp.	P.P. Run 9A, Effl. Cont. Comp.	P. P. Run 9A, Effl. Test Comp.	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	87	69	22	
Volatile Suspended Solids	51	53	11	
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	68	94		
COD	255	230	159	
Grease	29	26	3	
Appearance	No Floatables	No Floatables	No Floatables	
Odor	Normal Sewage	None	Normal Sewage	
Chloride	130			
pH	7.2	7.1	11.3	
Turbidity (JTU)	33	36	5	
Settleable Solids (ml/l/hr)	3.0	<0.1	<0.1	

Comments:

Analyst J. Sehgal, M. Lipschuetz — Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/14-15/71

Report to Dr. Parker — Date Received 1/15/71

Copies to — Date Reported 1/25/71

Analysis No.	12440	12441	12442	12443
Source of Sample	P.P. Run 10, Inf. Comp., 14-15	P.P. Run 10, Eff. Test Comp. Filt. 14-15	P.P. Run 10, Effl. Cont. Comp., 14-15	P.P. Run 10, Eff. Test Unfiltered, 14, 5pm.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	97	5	78	49
Volatile Suspended Solids	80	5	38	29
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	136	33		26
COD	356	130	214	176
Grease	43	5	24	7
Appearance	No Floatables	No Floatables Clear	No Floatables	No Floatables
Odor	Normal Sewage	None	Normal Sewage	None
Chloride as Cl	411			
pH	7.6	7.1	7.4	6.7
Turbidity (JTU)	48	2.7	33	27
Settleable Solids (ml/l/hr)	1.5	<0.1	0.05	0.05

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/15/71

Report to: Dr. Parker — Date Received: 1/15/71

Copies to: — Date Reported: 1/25/71

Analysis No.	12444			
Source of Sample	P.P. Run 10 F.E. After Carbon, Grab, 1/15			
DETERMINATION	mg/l			
Total Suspended Solids	2			
Volatile Suspended Solids	1			
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	69			
COD	23			
Grease	2			
Appearance	No Floatables Clear			
Odor	None			
Chloride				
pH	7.7			
Turbidity (JTU)	0.85			
Settleable Solids (ml/l/hr)	<0.05			

Comments:

Analyst: S. Kirby

Reported by: Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/18-19/71

Report to Dr. Parker — Date Received 1/19/71

Copies to — Date Reported 1/25/71

Analysis No.	12456	12457	12458	12459
Source of Sample	P.P. Run 11, Settd. Effl. Comp	P.P. Run 11, Carb. Filt. Eff. Comp.	P.P. Run 11, Effl. Cont. Comp.	P.P. Run 11 Infl. Comp.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	38	16	67	120
Volatile Suspended Solids	18	6	42	87
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	26	57	115	116
COD	183	58	281	386
Grease	3	3	22	35
Appearance	Yellow	Water White	Usual	Usual
Odor	Usual	Usual	Usual	Usual
Chloride				617
Iron as Fe by AAS				0.17
pH	6.8	6.9	7.2	7.5
Turbidity (JTU)	23	3	42	57
Settleable Solids (ml/l/hr)	<0.1	<0.1	<0.1	2.5

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/18-19/71

Report to Dr. Parker — Date Received 1/19/71

Copies to — Date Reported 1/25/71

Analysis No.	12460			
Source of Sample	P.P. Run 11, Sand Filter Effl. Comp.			
DETERMINATION	mg/l			
Total Suspended Solids	15			
Volatile Suspended Solids	6			
Phenolphthalein Alkalinity ($CaCO_3$)	0			
Total Alkalinity ($CaCO_3$)	18			
COD	158			
Grease	1			
Appearance	Water White with Yellow Cast			
Odor	Usual			
Chloride				
Iron as Fe, By AAS	<0.01			
pH	6.7			
Turbidity (JTU)	8			
Settleable Solids (ml/l/hr)	<0.1			

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — **Date Collected** 1/19-20/71

Report to Mr. Parker — **Date Received** 1/20/71

Copies to — **Date Reported** 2/09/71

Analysis No.	12475	12476	12477	12478
Source of Sample	P.P. Run 12, Infl. Comp.	P.P. Run 12, Carb. Filt. Effl. Grab	P.P. Run 12, Floc. Sed. Effl. Comp.	P.P. Run 12, Sand Filt. Effl. Comp.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	120	10	* 39	*68
Volatile Suspended Solids	92	8	23	60
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	148	58	57	56
COD	363	68	168	141
Grease	35	4	7	5
Appearance	Usual	Usual	Usual	Usual
Odor	Usual	Usual	Usual	Usual
Chloride as Cl	1080			
pH	7.2	6.6	6.9	7.0
Turbidity (JTU)	60	3.1	29	10
Settleable Solids (ml/l/hr)	2.5	<0.1	<0.1	<0.1

Comments:

*These results are doubtful. When repeated on the portions preserved with mercuric chloride, the results for total suspended solids were 52 mg. per liter for No. 12477, and 21 mg. per liter for No. 12478.

Analyst S. Kirby

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/19-20/71

Report to Mr. Parker — Date Received 1/20/71

Copies to — Date Reported 2/09/71

Analysis No.	12479			
Source of Sample	P.P. Run 12, Effl. Cont. Comp.			
DETERMINATION	mg/1			
Total Suspended Solids	*25			
Volatile Suspended Solids	21			
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)				
COD	239			
Grease	23			
Appearance	Usual			
Odor	Usual			
Chloride				
pH	7.2			
Turbidity (JTU)	39			
Settleable Solids (ml/1/hr)	<0.1			

Comments:

*Result doubtful. When repeated on portion of sample preserved with mercuric chloride, total suspended solids were 88 mg/1.

Analyst S. Kirby

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/21/71

Report to: Mr. Parker — Date Received: 1/21/71

Copies to: — Date Reported: 2/08/71

Analysis No.	12489	12490	12491	12492
Source of Sample	P.P. Run 13, Infl. Comp.	P.P. Run 13, Sand Filt. Effl.	P.P. Run 13, Floc Sed. Effl.	P.P. Run 13, Carb. Filt. Effl. Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	136	10	29	6
Volatile Suspended Solids	117	8	21	6
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	141	44	44	44
COD	367	115	147	69
Grease	36	5	4	3
Appearance	Usual	*	*	*
Odor	Usual	Usual	Usual	Usual
Chloride (on Infl. Only) as Cl	1670			
pH	7.0	6.6	6.4	6.3
Turbidity (JTU)	54	4.9	14	1.5
Settleable Solids (ml/l/hr)	2.5	<0.1	<0.1	<0.1

Comments:

* Appearance:
Sample No. 12490- Yellow cast, Turbid Suspended Matter
Sample No. 12491- Turbid, Yellow Floc on Bottom of Becker looks like Ferric Hydroxide
Sample No. 12492- Water White, Turbid.

Analyst: S. Kirby, A. Jeong

Reported by: Morris Lipschuetz (signature) Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/20-21/71

Report to: Mr. Parker — Date Received: 1/21/71

Copies to: — Date Reported: 2/08/71

Analysis No.	12493			
Source of Sample	P.P. Run 13, Effl. Control. Comp.			
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	96			
Volatile Suspended Solids	82			
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)				
COD	295			
Grease	25			
Appearance	Usual			
Odor	Usual			
Chloride				
pH	7.0			
Turbidity (JTU)	46			
Settleable Solids (ml/l/hr)	0.25			

Comments:

Analyst: S. Kirby, A. Jeong

Reported by: Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers

Date Collected 1/22/71

Report to Dr. Parker

Date Received 1/22/71

Copies to

Date Reported 2/08/71

Analysis No.	12502	12503	12504	12505
Source of Sample	P.P. Run 14, Flot. infl.	P.P. Run 14, Flot. Effl.	P.P. Run 15 Flot. Infl.	P.P. Run 15 Flot. Effl.
DETERMINATION	mg/1	mg/1	mg/1	mg/1
Chemical Oxygen Demand (COD)	132	98	140	94
Total Suspended Solids (mg/1)	77	45	67	31
Turbidity (JTU)	39	34	39	31

Comments:

Analyst A. Jeong, P. Frank

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/22/71

Report to Dr. Parker — Date Received 1/25/71

Copies to — Date Reported 2/01/71

Analysis No.	12506	12507	12508	12509
Source of Sample	P.P. Run 16, Flot. Inf.	P.P. Run 16 Flt. Effl.	P.P. Run 17 Flot Infl.	P.P. Run 17 Flot. Effl.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	250	90	210	94
Volatile Suspended Solids	210	70	170	75
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	117	126	134	130
COD	596	258	570	426
Grease	105	34	74	29
Appearance	Turbid	Turbid	Turbid	Turbid
Odor	None	None	None	None
Chloride				
pH	6.8	6.7	6.8	6.9
Turbidity (JTU)	100	58	90	58
Settleable Solids (ml/l/hr)	7	<0.1	9	<0.1

Comments:

Analyst P. Parsons, P. Frank, A.Jeong

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/22/71

Report to: Dr. Parker — Date Received: 1/25/71

Copies to: — Date Reported: 2/01/71

Analysis No.	12510	12511		
Source of Sample	P.P. Run 18 Flot. Infl.	P. P. Run 18 Flot. Effl.		
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	150	74		
Volatile Suspended Solids	130	58		
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	142	143		
COD	536	391		
Grease	61	40		
Appearance	Turbid	Turbid		
Odor	None	None		
Chloride				
pH	7.1	7.0		
Turbidity (JTU)	80	50		
Settleable Solids (ml/l/hr)	9	<0.1		

Comments:

Analyst: P. Parsons, P. Frank, A. Jeong — Reported by: Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell C onsulting Engineers — Date Collected: 1/25/71

Report to: Mr. Parker — Date Received: 1/26/71

Copies to: — Date Reported: 2/09/71

Analysis No.	12517	12518	12519	12520
Source of Sample	P.P. Run 19, Infl. to Flot Unit	P.P. Run 19, Effl. fr. Flot. Unit	P.P. Run 20, Infl. to Flot. Unit	P.P. Run 20, Effl. fr. Flot. Unit
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	200	45	260	30
Volatile Suspended Solids	140	34	150	20
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	108	55	24	31
COD	396	313	525	194
Grease	<0.1	1.6	38	2.0
Appearance	Usual	Slightly Turbid	Usual	Slightly Turbid
Odor	Normal	None	Normal	None
Chloride as Cl		1500		
pH	6.9	6.5	5.9	6.2
Turbidity (JTU)	79	16	94	14
Settleable Solids (ml/l/hr)	3.5	<0.1	37.0	<0.1

Comments:

Analyst: P. Frank, J. Tyler

Reported by: Morris Lipschuetz (signature: Morris Lipschuetz)

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/25/71

Report to Mr. Parker — Date Received 1/26/71

Copies to — Date Reported 2/19/71

Analysis No.	12521	12522		
Source of Sample	P.P. Run 21 Inf. to Flot Unit	P.P. Run 21, Eff. Fr. Flot Unit.		
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	280	17		
Volatile Suspended Solids	150	12		
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	30	25		
COD	433	177		
Grease	0.5	1.7		
Appearance	Normal	Relatively Clear		
Odor	None	None		
Chloride				
pH	6.3	6.1		
Turbidity (JTU)	94	6		
Settleable Solids (ml/l/hr)	39	<0.1		

Comments:

Analyst P. Frank, J. Tyler, A. Jeong

Reported by Morris Lipschuetz

Morris Lipschuetz

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BCL-19

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/26/71

Report to Mr. Parker — Date Received 1/26/71

Copies to — Date Reported 2/09/71

Analysis No.	12527	12528	12529	12530
Source of Sample	P.P. Run 22, Infl. to Flot.	P.P. Run 22, Effl. From Flot.	P.P. Run 23, Infl. to Flot.	P.P. Run 23, Effl. From Flo
DETERMINATION	mg/1	mg/1	mg/1	mg/1
Total Suspended Solids	180	12	210	22
Volatile Suspended Solids	130	10	140	17
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	69	64	72	65
COD	272	115	317	154
Grease	Nil	Nil	Nil	0.8
Appearance	Normal		Normal	
Odor	Normal	None	Normal	None
Chloride as Cl				1270
pH	6.5	6.7	6.6	6.8
Turbidity (JTU)	51	7.3	53	10
Settleable Solids (ml/l/hr)	21	<0.1	20	<0.1

Comments:

Analyst S. Kirby, J. Tyler

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/26/71

Report to Mr. Parker — Date Received 1/26/71

Copies to — Date Reported 2/19/71

Analysis No.	12531	12532		
Source of Sample	P.P. Run 24 Infl. to Flot.	P.P. Run 24, Effl. From Flot.		
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	120	120		
Volatile Suspended Solids	94	56		
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	72	74		
COD	369	233		
Grease	Nil	5.8		
Appearance	Normal	Turbid		
Odor	Normal	None		
Chloride				
pH	6.7	6.8		
Turbidity (JTU)	60	35		
Settleable Solids (ml/l/hr)	17	3.5		

Comments:

Analyst P. Frank, J. Tyler, A. Jeong — Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/27/71

Report to: Mr. Parker — Date Received: 1/27/71

Copies to: — Date Reported: 2/19/71

Analysis No.	12534	12535	12536	12537
Source of Sample	P.P. Run 25 Inf. to Flot. Unit	P.P. Run 25 Eff. Fr. Flot. Unit	P.P. Run 26, Inf. to Flot Unit	P.P. Run 26 Eff. fr. Flot Unit
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	130	67	180	45
Volatile Suspended Solids	82	46	100	24
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	200	206	233	227
COD	308	221	324	212
Grease	5.1	Nil	25.5	5.0
Appearance	Normal	Some Turbidity	Normal	Some Turbidity
Odor	Normal	Questionable	Questionable	Questionable
Chloride as Cl		1110		
pH	7.6	8.2	8.7	8.4
Turbidity (JTU)	54	24	72	19
Settleable Solids (ml/l/hr)	0.8	<<0.1	6.5	<<0.1

Comments:

Analyst: P. Frank, J. Tyler, A. Jeong

Reported by: Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers

Date Collected

Report to Mr. Parker

Date Received 1/27/71

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Date Reported 2/19/71

Analysis No.	12538	12539		
Source of Sample	P.P. Run 27, Inf. to Flot Unit	P.P. Run 27, Effl. From Flot. Unit		
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	230	37		
Volatile Suspended Solids	130	27		
Phenolphthalein Alkalinity ($CaCO_3$)	0	0		
Total Alkalinity ($CaCO_3$)	248	227		
COD	349	222		
Grease	Nil	5.3		
Appearance	Normal	Some Turbidity		
Odor	Normal	Questionable		
Chloride				
pH	8.5	8.4		
Turbidity (JTU)	84	16		
Settleable Solids (ml/l/hr)	7.8	<<0.1		

Comments:

Analyst P. Frank, J. Tyler, A. Jeong

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/28/71

Report to Mr. Parker — Date Received 1/28/71

Copies to — Date Reported 2/16/71

Analysis No.	12549	12550	12551	12552
Source of Sample	P.P. Run 28, Sett. Sewage	P.P. Run 28, Eff. Fr. Flot. Unit	P.P. Run 29, Sett. Sewage	P.P. Run 29, Eff fr. Flot. Unit
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	96	14	110	22
Volatile Suspended Solids	84	12	98	15
Phenolphthalein Alkalinity ($CaCO_3$)		151		174
Total Alkalinity ($CaCO_3$)	124	277	130	294
COD	319	155	339	130
Grease	3	2	3	1
Appearance	Normal	Relatively Clear	Normal	Relatively Clear
Odor	Normal	Ammonia-Like	Normal	Ammonia-Like
Chloride as Cl	1216			
pH	7.1	10.0	7.5	10.5
Turbidity (JTU)	45	5	50	5
Settleable Solids (ml/l/hr)	0.7	<0.1	1.0	<0.1

Comments:

Analyst P. Frank, J. Tyler, A. Jeong

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/28/71

Report to Mr. Parker — Date Received 1/28/71

Copies to — Date Reported 2/16/71

Analysis No.	12553	12554		
Source of Sample	P.P. Run 30, Sett. Sewage	P.P. Run 30, Eff. fr. Flot. Unit		
DETERMINATION	mg/1	mg/1		
Total Suspended Solids	120	91		
Volatile Suspended Solids	100	71		
Phenolphthalein Alkalinity ($CaCO_3$)	0	144		
Total Alkalinity ($CaCO_3$)	126	220		
COD	355	201		
Grease	2	1		
Appearance	Normal	Some Turbidity		
Odor	Normal	Ammonia-like		
Chloride				
pH	7.4	10.7		
Turbidity (JTU)	52	26		
Settleable Solids (ml/1/hr)	0.8	0.5		

Comments:

Analyst P. Frank, J. Tyler, A. Jeong — Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown And Caldwell Consulting Engineers — Date Collected 2/3/71

Report to Mr. Parker — Date Received 2/3/71

Copies to — Date Reported 2/16/71

Analysis No.	12590	12591	12592	12593
Source of Sample	P.P. Run 31, Infl.	P.P. Run 31, Sett. Sewage	P.P. Run 31, Flot. Effl.	P.P. Run 32, Flot. Effl.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	220	89	18	80
Volatile Suspended Solids	180		9	42
Phenolphthalein Alkalinity ($CaCO_3$)			166	168
Total Alkalinity ($CaCO_3$)	160		280	284
COD	486		166	254
Grease	59		4	11
Appearance	Normal		Slight Turbidity	Some Turbidity
Odor	Normal		Ammonia-like	Ammonia-like
Chloride as Cl	995			
pH	7.8		10.5	10.7
Turbidity (JTU)	73	37	7.8	23
Settleable Solids (ml/l/hr)	10		<0.1	0.3

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz — Reported by Morris Lipschuetz (signed: Morris Lipschuetz)

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/3/71

Report to Mr. Parker — Date Received 2/3/71

Copies to — Date Reported 2/16/71

Analysis No.	12594	12595	12596	12597
Source of Sample	P.P. Run 32, Sett. Sewage	P.P. Run 32, Infl.	P.P. Run 33, Sett. Sewage	P.P. Run 33, Flot. Effl.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	100	300	110	100
Volatile Suspended Solids		180		58
Phenolphthalein Alkalinity ($CaCO_3$)				175
Total Alkalinity ($CaCO_3$)		151		287
COD		621		276
Grease		64		14
Appearance		Normal		Some Turbidity
Odor		Normal		Ammonia-like
Chloride				
pH		7.6		10.7
Turbidity (JTU)	48	74	57	36
Settleable Solids (ml/l/hr)		12		1.2

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/3/71

Report to Mr. Parker — Date Received 2/3/71

Copies to — Date Reported 2/17/71

Analysis No.	12598			
Source of Sample	P.P. Run 33 Infl.			
DETERMINATION	mg/l			
Total Suspended Solids	200			
Volatile Suspended Solids	160			
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	134			
COD	552			
Grease	68			
Appearance	Normal			
Odor	Normal			
Chloride				
pH	7.5			
Turbidity (JTU)	82			
Settleable Solids (ml/l/hr)	6			

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz — Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/4/71

Report to Mr. Parker — Date Received 2/4/71

Copies to — Date Reported 2/17/71

Analysis No.	12600	12601	12602	12603
Source of Sample	P.P. Run 34, Infl.	P.P. Run 34, Flot. Effl.	P.P. Run 34 Sett. Sewage	P. P. Run 35, Sett. Sewage
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	230	9	88	90
Volatile Suspended Solids	190	6		
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	137	35		
COD	499	146		
Grease	50	9		
Appearance	Normal	Slightly Turbid		
Odor	Normal	None		
Chloride as Cl	1860			
pH	7.6	6.5		
Turbidity (JTU)	71	4.2	43	48
Settleable Solids (ml/l/hr)	11	<0.1		

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/4/71

Report to Mr. Parker — Date Received 2/4/71

Copies to — Date Reported 2/17/71

Analysis No.	12604	12605		
Source of Sample	P.P. Run 35 Infl.	P.P. Run 35 Flot. Effl.		
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	230	68		
Volatile Suspended Solids	190	42		
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	132	39		
COD	528	227		
Grease	59	4		
Appearance	Normal	Some Turbidity		
Odor	Normal	None		
Chloride				
pH	7.6	6.4		
Turbidity (JTU)	90	21		
Settleable Solids (ml/l/hr)	13.5	2.5		

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz — Reported by Morris Lipschuetz (signed: Morris Lipschuetz)

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers | Date Collected 2/4/71

Report to Mr. Parker | Date Received 2/4/71

Copies to | Date Reported 2/17/71

Analysis No.	12606	12607	12608	12609
Source of Sample	P.P. Run 36 Sett. Sewage	P.P. Run 36 Flot. Effl.	P.P. Run 37 Sett. Sewage	P.P. Run 37 Flot. Effl.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	58	17	110	56
Volatile Suspended Solids	44	8	85	33
Phenolphthalein Alkalinity ($CaCO_3$)				
Total Alkalinity ($CaCO_3$)	134	41	153	27
COD	383	152	391	206
Grease	48	15	48	10
Appearance	Normal	Slightly Turbid	Normal	Some Turbidity
Odor	Normal	None	Normal	None
Chloride as Cl	870			
pH	7.6	6.4	7.5	6.4
Turbidity (JTU)	62	7.8	63	27
Settleable Solids (ml/l/hr)	1.2	<0.1	1	0.4

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/5/71

Report to Mr. Parker — Date Received 2/5/71

Copies to — Date Reported 2/17/71

Analysis No.	12614	12615	12616	12617
Source of Sample	P.P. Run 38, Sett. Sew. Infl.	P.P. Run 38, Float. Effl.	P.P. Run 39, Sett. Sew. Infl.	P.P. Run 39, Float. Effl.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	67	10	85	12
Volatile Suspended Solids	44	10	51	10
Phenolphthalein Alkalinity ($CaCO_3$)		129		25
Total Alkalinity ($CaCO_3$)	118	261	157	120
COD	221	109	323	170
Grease	26	10	32	4
Appearance	Normal	Slightly Turbid	Normal	Slightly Turbid
Odor	Normal	None	Normal	None
Chloride as Cl			1410	
pH	7.3	10.1	7.4	10.4
Turbidity (JTU)	31	4.8	46	6.6
Settleable Solids (ml/l/hr)	<0.1	<0.1	0.35	<0.1

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz — Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/5/71

Report to Mr. Parker — Date Received 2/5/71

Copies to — Date Reported 2/17/71

Analysis No.	12618	12619		
Source of Sample	P.P. Run 40 Sett. Sew. Infl.	P.P. Run 40 Float. Effl.		
DETERMINATION	mg/l	mg/l		
Total Suspended Solids	130	61		
Volatile Suspended Solids	71	46		
Phenolphthalein Alkalinity ($CaCO_3$)		71		
Total Alkalinity ($CaCO_3$)	145	227		
COD	424	222		
Grease	38	9		
Appearance	Normal	Turbid		
Odor	Normal	None		
Chloride				
pH	7.3	10.3		
Turbidity (JTU)	54	18		
Settleable Solids (ml/l/hr)	2	0.7		

Comments:

Analyst P. Frank, A. Jeong, M. Lipschuetz — Reported by Morris Lipschuetz

Morris Lipschuetz

BROWN AND CALDWELL LABORATORIES 66 MINT STREET, SAN FRANCISCO, CALIFORNIA, 94103 • Tel: (415) 982-2442

BCL-19

BROWN AND CALDWELL LABORATORIES
66 MINT STREET
SAN FRANCISCO 94103
TEL. 415 · 982-2442

SUBJECT: Pilot Plant Project
Color

REPORT TO: Mr. Parker

DATE REPORTED: January 8, 1971

Analysis No.	12363	12364	12365
Sample Source	Run 5, Influent Composite Jan. 5/6, 1971	Run 5 Test Effluent Composite Jan. 5/6, 1971	Run 5 Control Effluent Composite Jan. 5/6, 1971
	%T	%T	%T
400 µm	73 1/2	84	75 1/2
500	87	96	89
600	93	99	94 1/2
700	94 1/2	99	95 1/2
800	72 1/2	85	75
	Absorbance	Absorbance	Absorbance
400 µm	0.133	0.075	0.122
500	0.062	0.019	0.050
600	0.032	0.004	0.026
700	0.025	0.006	0.019
800	0.139	0.069	0.125

Absorbance measurements made after filtration thru 0.45 µm Millipore filters. Beckman DU, 50 mm. cuvettes, with distilled water as reference liquid.

Morris Lipschuetz
Morris Lipschuetz
Laboratory Supervisor

BROWN AND CALDWELL LABORATORIES
66 MINT STREET
SAN FRANCISCO 94103
TEL. 415 · 982-2442

SUBJECT: Pilot Plant Project
Color, 1/19/71, Run 11

REPORT TO: Mr. Parker

DATE REPORTED: February 11, 1971

Analysis No.	12456	12457	12458
Sample Source	Settled Test Effluent	Carbon Filtered Effluent	Control Effluent
	Absorbance	Absorbance	Absorbance
400 µm	0.042	0.007	0.149
500	0.022	0.006	0.063
600	0.006	0.007	0.034
700	0.004	0.008	0.021
800	0.082	0.065	0.143
	%T	%T	%T
400 µm	90.7	98.7	70.9
500	95.0	98.8	86.3
600	98.7	98.6	92.3
700	99.1	98.2	95.2
800	83.0	86.1	72.0

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66 MINT STREET
SAN FRANCISCO 94103
TEL. 415 • 982-2442

SUBJECT: Pilot Plant Project
Color, 1/19/71, Run 11

REPORT TO: Mr. Parker

DATE REPORTED: February 11, 1971

Analysis No.	12459	12460
Sample Source	Influent	Sand Filtered Effluent
	Absorbance	Absorbance
400 µm	0.144	0.038
500	0.071	0.018
600	0.036	0.006
700	0.027	0.003
800	0.163	0.075
	%T	%T
400 µm	71.8	91.5
500	85.0	95.8
600	92.1	98.8
700	94.1	99.4
800	68.8	84.2

Morris Lipschuetz
Morris Lipschuetz
Laboratory Supervisor

BROWN AND CALDWELL LABORATORIES
66 MINT STREET
SAN FRANCISCO 94103
TEL. 415 • 982-2442

SUBJECT: Pilot Plant Project

REPORT TO: Mr. Parker

DATE REPORTED: February 19, 1971

Analysis No.	12604	12605
Sample Source	Influent Run 35 Absorbance	Effluent Run 35 Absorbance
400 um	.159	.054
500	.052	.012
600	.024	.000
700	.013	.000
800	.123	.061
	%T	%T
400 um	69.4	87.4
500	88.8	97.2
600	94.9	100.0
700	97.1	100.0
800	75.4	87.0

Morris Sifpochusty

BROWN AND CALDWELL LABORATORIES
66 MINT STREET
SAN FRANCISCO 94103
TEL. 415 · 982-2442

SUBJECT: Pilot Plant Project

REPORT TO: Mr. Parker

DATE REPORTED: February 19, 1971

Analysis No.	12551 Run 29	12552 Run 29
Sample Source	Settled Sewage	Flot'n Effluent
	Absorbance	Absorbance
400 um	.153	.084
500	.055	.018
600	.027	.004
700	.017	.000
800	.123	.072
	%T	%T
400 um	70.2	82.4
500	88.2	95.9
600	94.0	99.2
700	96.1	100.0
800	75.4	84.8

Morris Lipschuetz

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 1/6/71

Reported 1/11/71

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL REPORT TO DENNEY S. PARKER, PhD

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	71013		71014	
SOURCE OF SAMPLE: Pilot Plant Run #5	Settled Effluent		Lime Treated Effluent	
DATE COLLECTED:	1/5-6/71		1/5-6/71	
TIME COLLECTED:				

Source of Dilution Water Ocean Water, Steinhart Aquarium
Number of Fish per Concentration 10

Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.3		8.5*	
Total Alkalinity ($CaCO_3$)	MG/L	--		--	
Residual Chlorine	MG/L	<0.1		<0.1	
Dissolved Oxygen	MG/L	8.6		8.9	
BIOASSAY RESULTS (96 HOURS):					
Survival in Undiluted Wastewater	%	40		100	
Median Tolerance Limit (TLm)	%	91		>100	

COMMENTS: * The pH of the wastewater sample was adjusted to 8.5 with Sulfuric Acid prior to testing.

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN, SB Analyst

[signature] Director
R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 1/19/71

Reported 1/25/71

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL REPORT TO DR. DENNY S. PARKER

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	71057	71058	71059	71060
SOURCE OF SAMPLE: PILOT PLANT RUN NO. 11	Control Effluent	Floc. Sed. Effluent	Sand Filter Effluent	Carbon Filter Effluent
DATE COLLECTED:	1/18-19/71	1/18-19/71	1/18-19/71	1/18-19/71
TIME COLLECTED:				

Source of Dilution Water Ocean Water, Steinhart Aquarium
Number of Fish per Concentration 10

Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.7	7.0*	7.0*	7.0*
Total Alkalinity ($CaCO_3$)	MG/L	--	--	--	--
Residual Chlorine	MG/L	--	--	--	--
Dissolved Oxygen	MG/L	6.9	7.9	8.0	7.7
BIOASSAY RESULTS (96 HOURS)					
Survival in Undiluted Wastewater	%	20	70	80	70
Median Tolerance Limit (TLm)	%	32	>100	>100	>100

COMMENTS: *pH adjusted to 7.0 with NaOH prior to testing.

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

T. Nakamura Analyst

R. A. Ryder Director

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received	1/28/71
Reported	2/5/71

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN & CALDWELL REPORT TO DR. DENNEY S. PARKER

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	71103		71104	
SOURCE OF SAMPLE: PILOT PLANT RUN 29	Settled Effluent		Flotation Effluent	
DATE COLLECTED:	1/27-28/71		1/27-28/71	
TIME COLLECTED:				

Source of Dilution Water Ocean Water, Steinhart
Number of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature $20 \pm 0.5^{o}C$

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.6		8.5*	
Total Alkalinity ($CaCO_3$)	MG/L	---		---	
Residual Chlorine	MG/L	<0.1		<0.1	
Dissolved Oxygen	MG/L	7.4		8.3	
BIOASSAY RESULTS (96 HOURS)					
Survival in Undiluted Wastewater	%	20		100	
Median Tolerance Limit (TLm)	%	84		> 100	

COMMENTS:

* pH of the Wastewater adjusted to 8.5 with H_2SO_4 prior to testing.

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN Analyst

T. Nakamura Director
for R. A. Ryder

PACIFIC ENVIRONMENTAL LABORATORY
657 Howard Street, San Francisco, 94105
Phone - (415) 362-6065

Received 2/4/71

Reported 2/11/71

FISH TOXICITY WASTEWATER BIOASSAY REPORT

FOR BROWN AND CALDWELL REPORT TO DR. DENNY S. PARKER

ADDRESS 66 MINT STREET, SAN FRANCISCO, CALIFORNIA 94103

LAB NO.	71137	71138			
SOURCE OF SAMPLE: Pilot Plant Run #35	Influent	Flotation Effluent			
DATE COLLECTED:	2/3-4/71	2/3-4/71			
TIME COLLECTED:					

Source of Dilution Water Ocean Water, Steinhart Aquarium
Number of Fish per Concentration 10
Test Fish Three Spine Stickleback
Source of Fish San Pablo Bay
Test Temperature 20 ± 0.5°C

Analysis	Units	ANALYTICAL RESULTS			
INITIAL WASTEWATER CHARACTERISTICS:					
pH	Unit	7.5	7.5		
Total Alkalinity ($CaCO_3$)	MG/L	--	--		
Residual Chlorine	MG/L	--	--		
Dissolved Oxygen	MG/L	6.7	8.9		
BIOASSAY RESULTS (96 HOURS)					
Survival in Undiluted Wastewater	%	0	50		
Median Tolerance Limit (TLm)	%	52	100		

COMMENTS:

Analysis by: "Standard Methods for the Examination of Water and Wastewater, Current Edition, APHA

TN, GN Analyst

Director
R. A. Ryder

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers

Date Collected: 1/5-6/71

Report to: Mr. Parker

Date Received: 1/6/71

Copies to:

Date Reported: 2/25/71

Analysis No.	12363	12364	12365	
Source of Sample	P.P. Influent Run 5	P.P. Test Effl. Run 5	P.P. Control Effluent, Run 5	
DETERMINATION	mg/l	mg/l	mg/l	
Ammonia (N)	9.1			
Organic Nitrogen (N)	14			
Total Kjeldahl Nitrogen (N)	23.1	19.6	22.2	
Total Phosphorus (PO_4)	29	5.6	24	
5-Day, 20°C, BOD	220	61	130	
Floatables		0.1	2	

Comments:

Analyst: S. Kirby, Tyler, A. Jeong, M. Lipschuetz

Reported by: Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers | Date Collected 1/18-19/71

Report to Mr. Parker | Date Received 1/19/71

Copies to | Date Reported 2/11/71

Analysis No.	12456	12457	12458	12459
Source of Sample	Settled P.P. Run 11 Effl. Comp.	P. P. Run 11, Carb. Filt. Eff. Comp.	P.P. Run 11, Eff. Cont. Comp.	P.P. Run 11, Infl. Comp.
DETERMINATION	mg/l	mg/l	mg/l	mg/l
5-Day BOD, 20°C.	70	6*	120	150
MBAS	2.0	0.08	2.1	4.0
Orthophosphate (PO_4)	0.4	<0.1	16	17
Total Phosphorus (PO_4)	0.4	<0.1	18	19
Organic Nitrogen (N)	13	5.6	10	14
Ammonia (N)	9.5	9.4	14	11
Color	**	**	**	**
Floatables	0.6		0.8	

Comments: *This value doubtful; depletion of the dissolved oxygen in BOD bottle at a 30x dilution was only 0.2 mg. per liter.

**See attached table.

Analyst A. Jeong, J. Tyler

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/19/71

Report to: Mr. Parker — Date Received: 1/19/71

Copies to: — Date Reported: 2/11/71

Analysis No.	12460			
Source of Sample	P.P. Run 11 Sand Filt. Effl.	Comp.		
DETERMINATION	mg/l			
5-Day BOD, 20°C	50			
MBAS	2.8			
Orthophosphate (PO_4)	<0.1			
Total Phosphorus (PO_4)	<0.1			
Organic Nitrogen (N)	10			
Ammonia (N)	7.7			
Color	**			

Comments:

** See attached table.

Analyst: A. Jeong, J. Tyler

Reported by: Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/28/71

Report to: Mr. Parker — Date Received: 1/29/71

Copies to: — Date Reported: 2/19/71

Analysis No.	12551	12552		
Source of Sample	P.P. Run 29 Sett. Sewage	P.P. Run 29 Flot'n Effluent		
DETERMINATION	mg/l	mg/l		
5-day, 20°C BOD	130	92		
MBAS	1.8	0.8		
Orthophosphate (PO_4)	11	<0.1		
Total Phosphorus (PO_4)	15	0.4		
Organic Nitrogen (N)	16	11		
Ammonia (N)	14	13		
Color	See Attached Sheet	See Attached Sheet		
Soluble Calcium as Ca	46	58		
Magnesium as Mg	77	72		

Comments:

Analyst: J. Tyler

Reported by: Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/05/71

Report to Mr. Parker — Date Received 2/05/71

Copies to — Date Reported 2/19/71

Analysis No.	12604	12605		
Source of Sample	P.P. Run 35 Influent	P.P. Run 35 Effluent		
DETERMINATION	mg/l	mg/l		
5-day, 20°C BOD	220	86		
MBAS	1.1	0.73		
Orthophosphate (PO_4)	13	<0.1		
Total Phosphorus (PO_4)	24	1.6		
Organic Nitrogen (N)	20	14		
Ammonia (N)	16	14		
Color	See Attached Sheet	See Attached Sheet		
Floatables	1.6	0.3		

Comments:

Analyst J. Tyler, P. Frank

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 12/30-31/70

Report to Mr. Parker — Date Received 12/31/70

Copies to — Date Reported 1/6/71

Analysis No.	12336	12337		
Source of Sample	Pilot Plant-Flocculator, 1000 h	Pilot Plant Waste Sludge, 1000 H		
DETERMINATION	RUN 3 mg/l	RUN 3 mg/l		
Total Suspended Solids	890	46,000		

Comments:

Analyst F. Mitchell

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/5-6/71

Report to Mr. Parker — Date Received 1/6/71

Copies to — Date Reported 1/14/71

Analysis No.	12366	12367	12368	
Source of Sample	P.P. Rapid Mix Grab, Run 5	P.P. Flocculator Grab, Run 5	P.P. Chem Sludge Grab, Run 5	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	600	890	15,400	

Comments: Job. No. F265 H

Analyst S. Kirby

Reported by Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 12/31/70

Report to Mr. Parker — Date Received 12/31/70

Copies to — Date Reported 1/6/71

Analysis No.	12238	12239	12240	
Source of Sample	Pilot Plant-Grab Influent, 10:00A Run 3	Pilot Plant-Grab Test Effluent, 10:00A Run 3	Pilot Plant, Grab Control Effluent, 10:00A Run 3	
DETERMINATION				
pH	7.2	10.8	7.4	
Turbidity (JTU)	68	19	38	

Comments:

Analyst M. Lipschuetz — Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown And Caldwell Consulting Engineers — Date Collected: 1/4-5/71

Report to: Mr. Parker — Date Received: 1/5/71

Copies to: — Date Reported: 1/8/71

Analysis No.	12347	12348	12349	12350
Source of Sample	Pilot Plant Run 4 Rapid Mix Grab	Pilot Plant Run 4 Flocculator Grab	Pilot Plant Run 4, Waste Primary Sludge Grab	Pilot Plant Run 4, Waste Chem Sludge Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	516	836	7,040	19,060

Comments:

Analyst: F. Mitchell

Reported by: Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/5-6/71

Report to Dr. Parker — Date Received 1/6/71

Copies to — Date Reported 1/14/71

Analysis No.	12369	12370	12371	
Source of Sample	P.P. Influent Grab, Run 5	P.P. Test Effl. Grab, Run 5	P.P. Control Effl. Grab, Run 5	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	270	40	100	

Comments: Job. NO. F265 H

Analyst S. Kirby — Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/7/71

Report to Mr. Parker — Date Received 1/7/71

Copies to — Date Reported 1/8/71

Analysis No.	12377	12378	12379	12380
Source of Sample	P.P. Run 6 Rapid Mix Grab	P.P. Run 6 Control Effl. Grab	P.P. Run 6-WST Chem. Sludge Grab	P.P. Run 6, Inf. Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	250	36	8300	450

Comments:

Analyst J. Sehgal

Reported by Morris Lipschuetz

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WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/7/71

Report to Mr. Parker — Date Received 1/7/71

Copies to — Date Reported 1/8/71

Analysis No.	12381	12382	12383	
Source of Sample	Pilot Plant Run 6 Test Effluent Grab	P.P. Run 6, Wst Prim. Sludge	P. P. Run 6, Floc. R Grab	
DETERMINATION	mg/l	mg/l	mg/l	
Total Suspended Solids	33	3600	230	

Comments:

Analyst J. Sehgal

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/8/71

Report to: Dr. Parker — Date Received: 1/8/71

Copies to: — Date Reported: 1/14/71

Analysis No.	12406	12407	12408	12409
Source of Sample	P.P. Run 7, Floc. R. Grab	P.P. Run 7,1/8 RPD Mix Grab	P.P. Run 7,WST Chem Sig. Grab	P.P. Run 7,WST, Prim. Sig. Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	870	570	11600	9000

Comments: Job. No. F265 H

Analyst: S. Kirby

Reported by: Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers | Date Collected 1/15/71

Report to Dr. Parker | Date Received 1/15/71

Copies to | Date Reported 1/27/71

Analysis No.	12436	12437	12438	12439
Source of Sample	P.P. Run 10, Infl. Grab	P.P. Run 10, Effl. Cont. Grab	P.P. Run 10, Effl. Test Before Filt. Grab	P.P. Run 10, Effl. Test After Filter Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	58	72	46	7
Hydrogen Ion Concentration (pH)	7.6	7.2	6.1	6.3
Turbidity (JTU)	48	29	24	1.7

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/15/71

Report to Dr. Parker — Date Received 1/15/71

Copies to — Date Reported 1/27/71

Analysis No.	12432	12433	12434	12435
Source of Sample	P.P. Run 10, Rpd. Mix Grab	P.P. Run 10, Chem. Sludge Wst. Grab	P.P. Run 10, Flocc'r Grab	P.P. Run 10, Pri. Sludge Wst. Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	260	3100	280	6500

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers

Date Collected 1/19/71

Report to Mr. Parker

Date Received 1/19/71

Copies to

Date Reported 1/22/71

Analysis No.	12469	12470	12471	12472
Source of Sample	P.P. Run 11, Floc. Sed. Effl.	P. P. Run 11, Sand Filter Effl. Grab	P. P. Run 11, Infl. Grab	P. P. Run 11, Rapid Mix Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	51	4	290	400

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/19/71

Report to Dr. Parker — Date Received 1/19/71

Copies to — Date Reported 1/22/71

Analysis No.	12464	12465	12466	12467	12468
Source of Sample	P. P. Run 11, Floc.'R Grab	P. P. Run 11, Carbon Filter Eff.	P. P. Run 11, WST. Pri. Slg. Grab	P.P. Run 11, WST. Chem Slg. Grab	P.P. Run 11, Eff. Control Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	260	1.2	6100	4000	72

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/20/71

Report to Dr. Parker — Date Received 1/20/71

Copies to — Date Reported 1/27/71

Analysis No.	12480	12481	12482	12483
Source of Sample	P.P. Run 12, Infl. Grab	P.P. Run 12, Effl. Control Grab	P.P. Run 12, Sand Filt. Effl. Grab	P.P. Run 12, F Sed. Effl. Gr
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	200	140	12	54

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/20/71

Report to Dr. Parker — Date Received 1/20/71

Copies to — Date Reported 1/27/71

Analysis No.	12484	12485	12486	12487
Source of Sample	P.P. Run 12, Flocc'r Grab	P.P. Run 12, Wst Chem. Slg. Grab	P.P. Run 12, Wst. Pri. Slg. Grab	P.P. Run 12, Rpd. Mix Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	280	4300	5900	280

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/21/71

Report to Dr. Parker — Date Received 1/21/71

Copies to — Date Reported 2/09/71

Analysis No.	12498	12499	12500	12501
Source of Sample	P.P. Run 13, Floc. R. Grab	P.P. Run 13, Infl. Grab	P.P. Run 13,Wst. Prim. Sldg. Grab	P.P. Run 13,W. Chem. Sl. Gr
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	310	230	16000	4200
Hydrogen Ion Conc. (pH)		7.0		
Turbidity (JTU)		77		

Comments:

Analyst P. Frank

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 1/21/71

Report to: Mr. Parker — Date Received: 1/21/71

Copies to: — Date Reported: 2/09/71

Analysis No.	12494	12495	12496	12497
Source of Sample	P.P. Run 13, Effl. Cont. Grab	P.P. Run 13, Sand Filt. Effl. Grab	P.P. Run 13, Rpd. Mix Grab	P.P. Run 13, Floc Sed. Mix Grab
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Total Suspended Solids	97	4	380	62
Chemical Oxygen Demand (COD)		107		
pH	7.1			6.2
Turbidity (JTU)	44			26

Comments:

Analyst: P. Frank, A. Jeong

Reported by: Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/22/71

Report to Dr. Parker — Date Received 1/25/71

Copies to — Date Reported 1/27/71

Analysis No.	12512	12513	12514	12515
Source of Sample	Foam P.P. Run 14	Foam P.P. Run 15	Foam P.P. Run 16	Foam P.P. Run 17
DETERMINATION	%	%	%	%
Total Solids	0.63	2.5	2.3	4.9

Comments:

Analyst P. Frank

Reported by Morris Lipschuetz
Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers Date Collected 1/22/71

Report to Dr. Parker Date Received 1/25/71

Copies to Date Reported 1/27/71

Analysis No.	12523	12524	12525	12526
Source of Sample	Foam P.P. Run 18	Foam P.P. Run 19	Foam P. P. Run 20	Foam P.P. Run 21
DETERMINATION	%	%	%	%
Total Solids	8.5	2.6	2.3	2.5

Comments:

Analyst P. Frank Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/27/71

Report to Mr. Parker — Date Received 1/27/71

Copies to — Date Reported 2/01/71

Analysis No.	12540	12541	12542	12543
Source of Sample	P.P. Run 22 Foam	P.P. Run 23 Foam	P.P. Run 24 Foam	P. P. Run 2 Foam
DETERMINATION	%	%	%	%
Total Solids	2.7	2.6	2.7	5.2

Comments:

Analyst P. Frank

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/27/71

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Copies to — Date Reported 2/01/71

Analysis No.	12544	12545		
Source of Sample	P.P. Run 26 Foam	P.P. Run 27 Foam		
DETERMINATION	%	%		
Total Solids	5.6	4.7		

Comments:

Analyst P. Frank

Reported by Morris Lipschutz

Morris Lipschutz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 1/28/71

Report to Dr. Parker — Date Received 1/29/71

Copies to — Date Reported 2/01/71

Analysis No.	12570	12571	12572	
Source of Sample	P.P. Run 28 Foam	P.P. Run 29 Foam	P.P. Run 30 Foam	
DETERMINATION	%	%	%	
Total Solids	4.5	4.6	4.3	

Comments:

Analyst P. Frank

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers

Date Collected 2/04/71

Report to Mr. Parker

Date Received 2/04/71

Copies to

Date Reported 2/10/71

Analysis No.	12611	12612	12613	
Source of Sample	P.P. Run 31 Foam	P.P. Run 32 Foam	P.P. Run 33 Foam	
DETERMINATION	%	%	%	
Total Solids	4.4	5.3	4.8	

Comments:

Analyst P. Frank

Reported by Morris Lipschutz

Morris Lipschutz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For	Brown and Caldwell Consulting Engineers	Date Collected	2/05/71
Report to	Mr. Parker	Date Received	2/05/71
Copies to		Date Reported	2/10/71

Analysis No.	12620	12621	12622	12623
Source of Sample	P.P. Run 34 Foam	P.P. Run 35 Foam	P.P. Run 36 Foam	P.P. Run Foam
DETERMINATION	%	%	%	%
Total Solids	3.4	3.6	2.9	2.4

Comments:

Analyst P. Frank

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 2/05/71

Report to: Mr. Parker — Date Received: 2/05/71

Copies to: — Date Reported: 2/10/71

Analysis No.	12624	12625	12631	
Source of Sample	P.P. Run 38 Foam	P.P. 39 Foam	P.P. Run 40 Foam	
DETERMINATION	%	%	%	
Total Solids	5.4	4.3	4.2	

Comments:

Analyst: P. Frank

Reported by: Morris Lipschuetz
Morris Lipschuetz

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WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell Consulting Engineers — Date Collected: 2/3/71

Report to: Dr. Parker — Date Received: 2/3/71

Copies to: — Date Reported: 2/19/71

Analysis No.	12590	12591	12592	12593
Source of Sample	P.P. Run 31 Influent	P.P. Run 31 Sett. Sewage	P.P. Run 31 Flot. Effluent	P.P. Run 32 Flot. Effluent
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Lead by AAS as *Pb	0.098	0.049	0.013	0.010

Comments:

*Boat Method.

Analyst: S. Kirby

Reported by: Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/3/71

Report to Dr. Parker — Date Received 2/3/71

Copies to — Date Reported 2/19/71

Analysis No.	12598			
Source of Sample	P.P. Run 33 Influent			
DETERMINATION	mg/l			
Lead by AAS as *Pb	0.128			

Comments:

*Boat Method.

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers | Date Collected 2/3/71

Report to Dr. Parker | Date Received 2/3/71

Copies to | Date Reported 2/19/71

Analysis No.	12594	12595	12596	12597
Source of Sample	P.P. Run 32 Sett. Sewage	P.P. Run 32 Influent	P.P. Run 33 Sett. Sewage	P.P. Run 33 Flot. Effl.
DETERMINATION	mg/1	mg/1	mg/1	mg/1
Lead by AAS as *Pb	0.045	0.133	0.116	0.042

Comments:

*Boat Method.

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/04/71

Report to Dr. Parker — Date Received 2/04/71

Copies to — Date Reported 3/09/71

Analysis No.	12600	12601	12602	12603
Source of Sample	P. P. Run 34 Influent	P. P. Run 34 Flot. Effluent	P. P. Run 34 Set.	P. P. Run 35 Set. Sewage
DETERMINATION	mg/l	mg/l	mg/l	mg/l
Lead by AAS as (Pb)	0.11	0.02	0.03	0.04

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell Consulting Engineers — Date Collected 2/04/71

Report to Dr. Parker — Date Received 2/04/71

Copies to — Date Reported 3/09/71

Analysis No.	12604	12605		
Source of Sample	P. P. Run 35 Influent	P. P. Run 35 Effluent		
DETERMINATION	mg/l	mg/l		
Lead by AAS as (Pb)	0.15	0.04		

Comments:

Analyst S. Kirby

Reported by Morris Lipschuetz

Morris Lipschuetz

WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For: Brown and Caldwell — Date Collected: Feb. 3, 1971

Report to: Dr. D. Parker — Date Received: Feb. 3, 1971

Copies to: — Date Reported: May 7, 1971

Analysis No.	12590	12591	12592	
Source of Sample	Pilot Plant Run 31 Influent	Pilot Plant Run 31 Settled Sew.	Pilot Plant Run31 Flotation Eff.	
DETERMINATION	mg/l	mg/l	mg/l	
Mercury as Hg by AAS	0.0050	0.00084	0.00080	

Comments:

Flameless technique used

Analyst: J. Tyler

Reported by: Morris Lipschuetz
Morris LipscHuetz

WATER ANALYSIS REPORT

BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell | Date Collected Feb. 3, 1971

Report to Dr. D. Parker | Date Received Feb.3,1971

Copies to | Date Reported May 7, 1971

Analysis No.	12595	12594	12593	
Source of Sample	Pilot Plant Run 32 Influent	Pilot Plant Run 32 Settled Sew.	Pilot Plant Run 32 Flotation Eff.	
DETERMINATION	mg/l	mg/l	mg/l	
Mercury as Hg by AAS	0.00014	0.000098	0.000064	

Comments:

Flameless technique used

Analyst J. Tyler

Reported by Morris Lipschuetz Morris Lipschuetz

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WATER ANALYSIS REPORT
BROWN AND CALDWELL LABORATORIES

For Brown and Caldwell — Date Collected Feb. 3, 1971

Report to Dr. D. Parker — Date Received Feb. 3, 1971

Copies to — Date Reported May 7, 1971

Analysis No.	12598	12596	12597	
Source of Sample	Pilot Plant Run 33 Influent	Pilot Plant Run 33 Settled Sew.	Pilot Plant Run 33 Flotation Eff.	
DETERMINATION	mg/l	mg/l	mg/l	
Mercury as Hg by AAS	0.0016	0.0020	0.00086	

Comments:

Flameless technique used

Analyst J. Tyler — Reported by Morris Lipschuetz

Morris Lipschuetz

APPENDIX E

ALTERNATIVE TREATMENT PROCESSES

ESTIMATED ADDITIONAL LAND REQUIREMENTS

APPENDIX E

ALTERNATIVE TREATMENT PROCESSES

ESTIMATED ADDITIONAL LAND REQUIREMENTS

NORTH POINT WATER POLLUTION CONTROL PLANT

Alternative	Additional land area required	Modification or improvement involved
N1	Sewer right-of-way	Parallel sludge force main
	Sewer right-of-way	Outfall
N2	Sewer right-of-way	Parallel sludge force main
	Sewer right-of-way	Outfall
	1/4 acre	Solids thickener tanks Southeast plant
N3	Sewer right-of-way	Parallel sludge force main
	Sewer right-of-way	Outfall
	1/2 acre	Solids thickener tanks Southeast plant
N4A	Sewer right-of-way	Parallel sludge force main
	Sewer right-of-way	Outfall
	3/4 acre	Solids thickener tanks Southeast plant
N4B	Sewer right-of-way	Parallel sludge force main
	Sewer right-of-way	Outfall
	3/4 acre	Dual media gravity filters
	1/2 acre	Solids thickener tanks Southeast plant

RICHMOND SUNSET WATER POLLUTION CONTROL PLANT

R1	Sewer right-of-way	Outfall
R2	Sewer right-of-way	Outfall
	1 acre	Dissolved air flotation tanks
R3	Sewer right-of-way	Outfall
R4A	Sewer right-of-way	Outfall
	3-1/2 acres	Carbonacious oxidation with secondary sedimentation tanks
R4B	Sewer right-of-way	Outfall
	1/2 acre	Incinerators

SOUTHEAST WATER POLLUTION CONTROL PLANT

Alternative	Additional land area required	Modification or improvement involved
S1	--	--
S2A	1 acre	Dissolved air flotation tanks
S2B	--	--
S3	4 acres	Carbonacious oxidation with secondary sedimentation tanks
S4A	1/4 acre 1/2 acre	Solid thickener tanks Incinerators
S4B	1/2 acre Sewer right-of-way 1/2 acre	Dual-media gravity filters Effluent sewer Solid thickener tanks